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Passiflora cacao (Passifloraceae), a New Species from Southern Bahia, Brazil

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ABSTRACT. *Passiflora cacao* Bernacci & M. M. Souza is described. The Passifloraceae has a limited known distribution area in southern Bahia, Brazil. This new species is not very abundant and occurs in a mountainous area associated with dense ombrophilous forest noteworthy for its great biodiversity, including many species of hummingbirds. *Passiflora cacao* is similar to *P. edulis* Sims, but it can easily be recognized by the cylindrical hypanthium and winged seeds. In addition, the flowers are usually smaller, with inner corona and outer corona series greater in number.

Key words: Atlantic forest, Bahia, Brazil, IUCN Red List, *Passiflora*, Passifloraceae.

Passiflora edulis Sims, the passion fruit, is the species in the Passifloraceae of greatest economic importance, being grown in many parts of the world (Meletti & Maia, 1999; Meletti et al., 2005; Bernacci et al., 2008). However, its close phylogenetic relationships are little known since its nearest relatives are unclear (Killip, 1938; Muschner et al., 2003; Yockteng & Nadot, 2004).

The Passifloraceae has ca. 500 to 600 described species (Escobar, 1988; Bernacci et al., 2005), but there could be 650 or even 750 species (Cronquist, 1981; Bernacci et al., 2005; Feuillet & MacDougal, 2007). The family's distribution is concentrated in the tropical regions of America and Africa, and its largest genus, *Passiflora* L., is clearly American, with a great number of species concentrated in South America, especially in the Andes (Ocampo et al., 2007).

Morphologically, *Passiflora incarnata* L. is the species most similar to *P. edulis*, and there are even taxonomic treatments in which the taxa are considered conspecific (Killip, 1938; Bernacci et al., 2008). While *P. incarnata* is native to North America, occurring in the United States, *P. edulis* is native to South and Central America (Killip, 1938; Cervi, 1997). Possibly, because of the broad natural distribution of *P. edulis*, the species presents considerable morphological variation associated with several scientific names attributed at the species level (Killip, 1938; Cervi, 1997; Bernacci et al., 2008). However, this morphological variation does not present any pattern that can be associated with geographic distribution, and several morphological characters vary independently (Killip, 1938; Cervi, 1997; Bernacci et al., 2008).

To study the Passifloraceae of Minas Gerais, the first author, together with A. C. Cervi and collaborators, collected samples and examined material in many regions of that state. In a complementary study intended to better understand species not often collected, the authors of this article examined material from regions adjacent to the state of Bahia. Great biodiversity has been observed for several plant groups in the ombrophilous forests of southern Bahia and northern Espírito Santo (Thomas et al., 1998;

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Amorim et al., 2005; Martini et al., 2007), and associated mountainous regions are also known to house a relatively high number of endemic species (Martinelli, 2007). The nearby flora of northeastern Minas Gerais is relatively little known, and through a quick assessment (Salino, 2006), new records and new species were observed, including *Passiflora boticarioana* Cervi (Cervi, 2006), which was described recently. Many forested areas in southern Bahia had been preserved from disturbance for long periods; however, with the decline of cacao agriculture, remaining forest areas are now threatened, with intensified human activity—mostly commercial wood cutting—eliminating native flora (Alger & Caldas, 1994; Martini et al., 2007).

The Serra Bonita, a mountain complex close to the southern Bahian towns of Camacan (15°25′09″S, 39°29′45″W) and Pau Brasil (15°27′51″S, 39°39′04″W), has a large altitudinal range, varying between 200 and 950 m. Located centrally within it is the Natural Heritage Private Reserve (RPPN) Serra Bonita (<http://www.uiracu.org.br/serrabonita.html>), and preliminary studies indicate that it has high biodiversity, including new species of plants and animals (WikiAves, 2008; Amorim & Leme, 2009; Amorim et al., 2009). In the RPPN we located a native population of *Passiflora* that is similar to, but can be clearly distinguished from, *P. edulis*. Thus, we conclude that it is a species not yet described that is related to *P. edulis* and occurs within its distribution area, although not occupying the same habitat.

Passiflora cacao Bernacci & M. M. Souza, sp. nov. TYPE: Brazil. São Paulo: cultivated in Nova Odessa, Instituto Plantarum, 30 Nov. 2007 (fl.), *L. C. Bernacci 4666* (holotype, IAC; isotype, MO). Figures 1, 2.

Haec species *Passiflorae eduli* Sims similis, sed ab ea hypanthio breviter cylindrico et seminibus alatis differt.

Herbaceous climber, glabrous, pubescent only in young portions, with tendrils; vigorous, stems ca. 2–2.7 mm diam., at the height of flowers. Stipules 7–8 mm, linear-triangular; petiole 19–45 × 1 mm, subcylindrical, with 1 pair of glands at the apex, 0.5–1 × 1–2 mm, concave, plane; blades 8–12.5 × 8.4–15 cm, membranous, sometimes pubescent along the midvein, especially on the adaxial surfaces, 3-lobed, rarely entire, rounded or obtuse at base, with serrated margin, acuminate apex; joined portion 2–3.8 cm; lobes diverging at 32°–53°, central lobe 5.9–8.5 × 2.6–4.4 cm, elliptic-ovate, lateral lobes 4–7.6 × 1.4–3.5 cm, lanceolate-ovate. Flowers solitary, 3–4 cm long, showy; pedicel 17–23 mm, articulated at 5–8 mm from the apex; bracts 3, green, verticillate at the height of articulation, 15–22 × 9–12 mm, margin ovate, serrate or entire, apex acute, sometimes apiculate, rounded base; hypanthium 8–12 × 4–6 mm, short-cylindrical; sepals fleshy, 15–19 × 7–8 mm, with 1 awn 1–2 mm, oblong, adaxially green, pubescent, abaxially whitish green; petals subequal to sepals, membranous, white; corona multiseriate, in 8 to 10 series; filaments filiform on 3 or 4 external series, radiate, wine-purple, 8–12 mm, apex sinuous, other internal series green, intermediate ca. 2–4 mm, smaller toward the interior, the most internal more distant than the others, 3 mm, apex curved inward; operculum 2–2.5 mm, ca. 6–8 mm from the hypanthial base, membranous at the base, filamented at the apex, erect; nectariferous ring, at 2 mm from hypanthial base, to 1 mm to inconspicuous; limen 6–8 mm, adnate to androgynophore, only 1–1.5 mm free; androgynophore 12–17 × 2 mm; filaments ca. 8 × 1–1.5 mm, ca. 1 mm connate at the base; anthers 7–8 × 2 mm; ovary 4.5–6 × 3–4 mm, elliptic, densely pubescent; styles 8–11 mm, pubescent; stigma 2–3 mm, very widely to obovate depressed, 2-lobed at apex. Berry ca. 4–5.5 × 3.5–4 cm, widely ovate, with many white spots, thick rind; seeds, ca. 30 to 70, 9.2–9.5 × 8–8.2 × 1.7–1.8 mm, retuse apex, mucronate, retuse base, asymmetric, brownish, reticulated, with winged margin, radially striate, whitish aril, slightly acid.

Distribution and phenology. *Passiflora cacao* is known from two locations in southern Bahia and was observed with flowers in December and with immature fruits in March and mature fruits in September. It was cultivated in the state of São Paulo, where it was observed with flowers in November, January, and March and with mature fruits in March. As with *P. edulis*, the species can present yellow or purple fruits, and yellow fruits were observed in the material from Ituberá, Bahia (*Guedes 9448*, ALCB, CEPEC), and in the material cultivated in the state of São Paulo (as cultivar accessions IAC-49560 and IAC-49568). Also, purple fruits were observed in material cultivated in Ilhéus, Bahia (Viana, 2009). Beyond its restricted occurrence, the new species is not abundant, and it may not have been collected or recognized, because of its similarities to *P. edulis*, by Amorim (in Flora da RPPN Serra Bonita, Bahia, Brazil) in a recent floral survey in the area.

IUCN Red List category. Since the material was collected within a radius of ca. 200 km, in light of current knowledge and information, according to IUCN Red List criteria (2001), the species should be

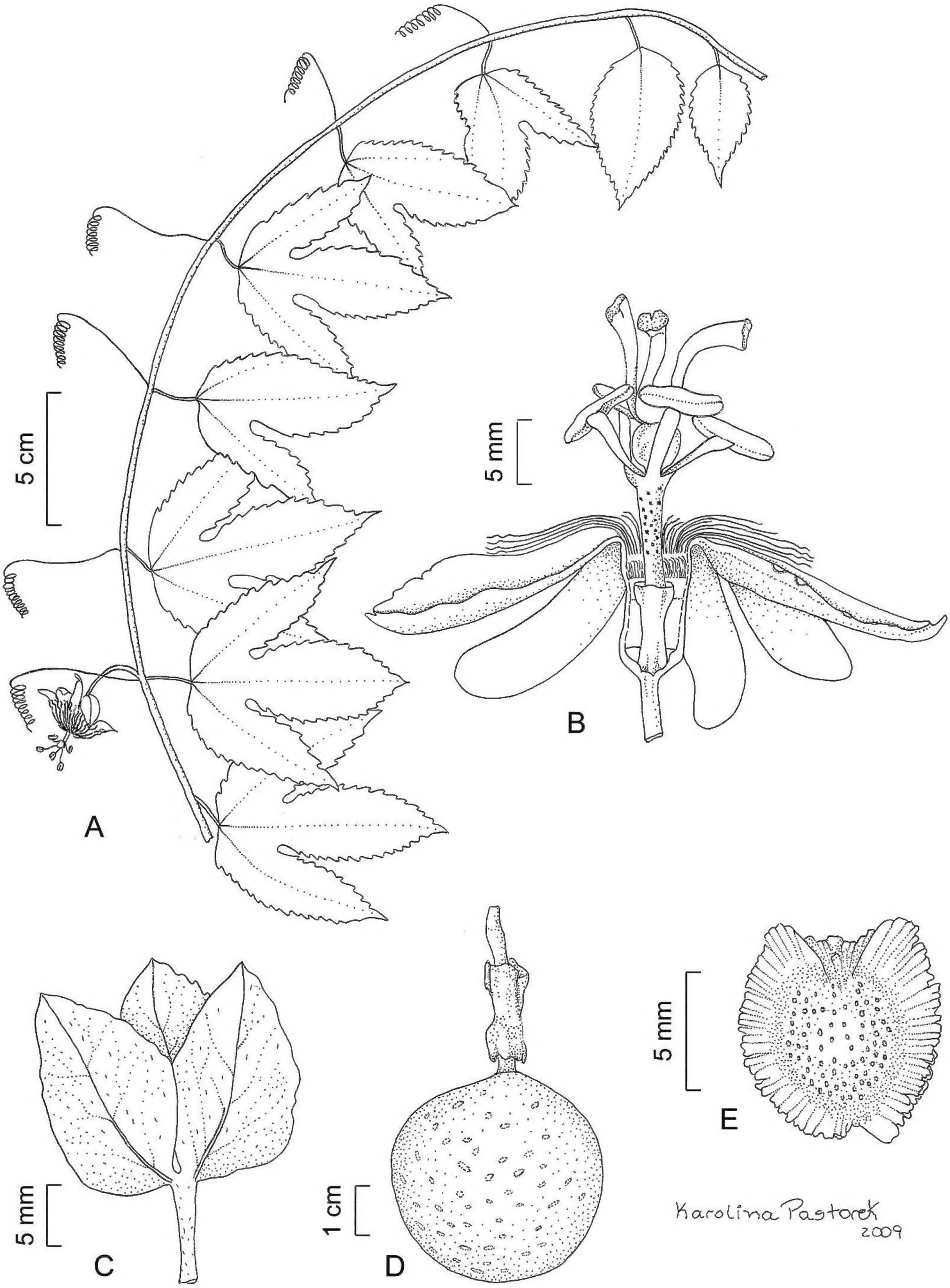
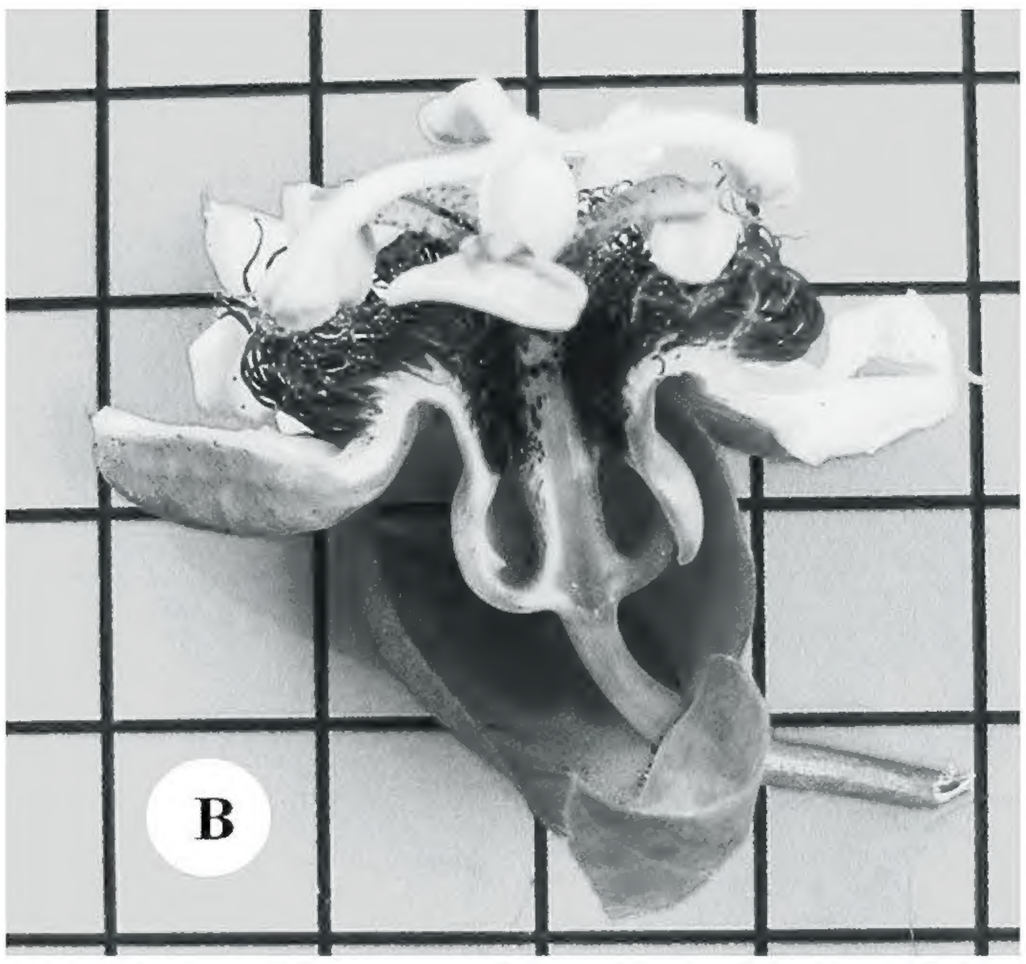
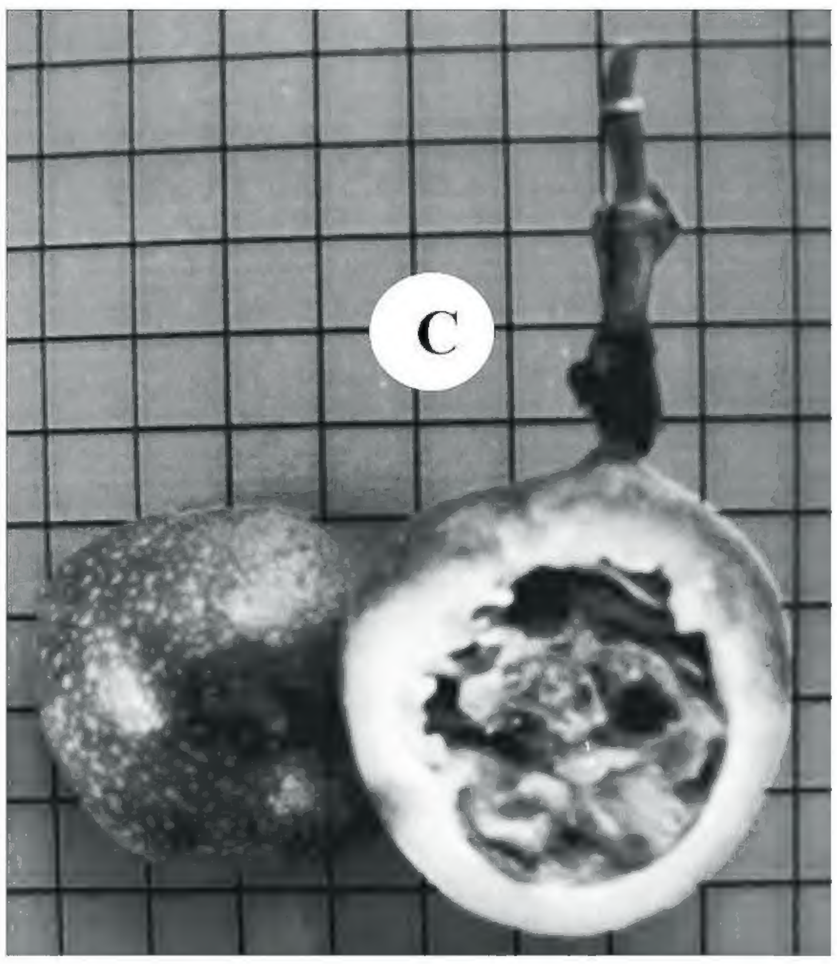


Figure 1. *Passiflora cacao* Bernacci & M. M. Souza. —A. Fertile habit. —B. Flower longitudinally dissected. —C. Peduncle highlighting the region of insertion and the bracts. —D. Fruit. —E. Seed with winged margin. Drawn from *L. C. Bernacci 4492* (IAC).





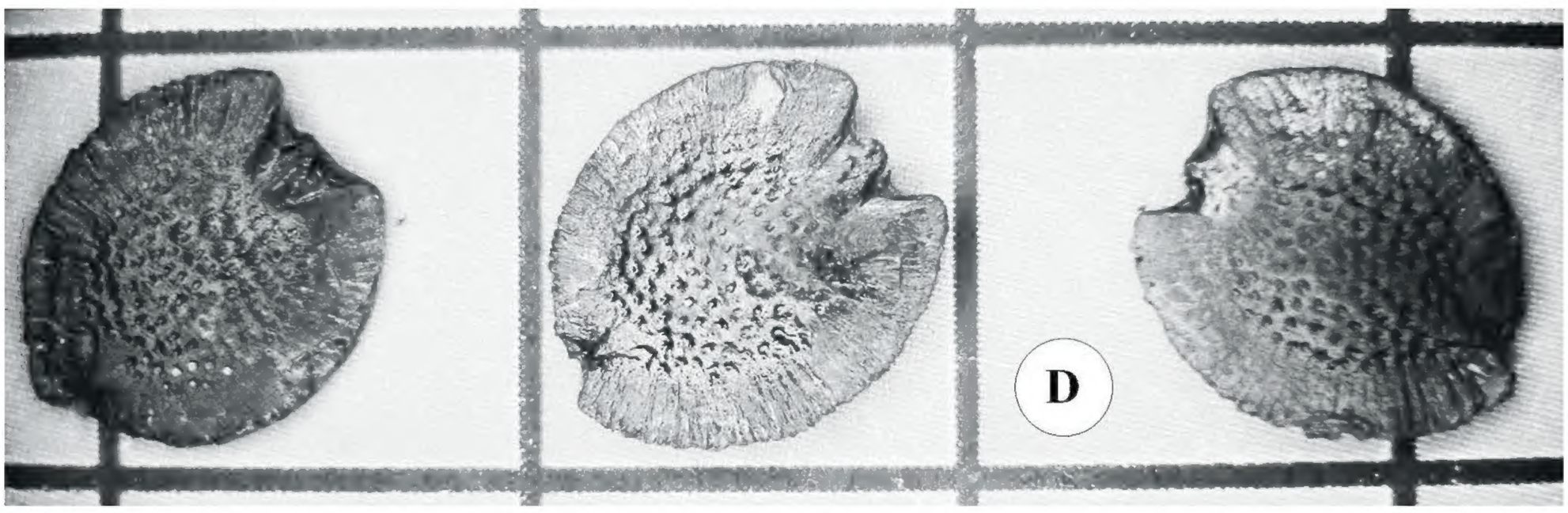


Figure 2. *Passiflora cacao* Bernacci & M. M. Souza. —A. Flower. —B. Flower longitudinally dissected. —C. Fruit longitudinally dissected. —D. Seed with winged margin. Photos of *L. C. Bernacci 4492* (IAC) by L. C. Bernacci.

considered Least Concern (LC) for the risk of extinction and additionally because it was found in a conservation unit (RPPN). Attempts at cultivation have not been successful beyond the F1 generation.

Etymology. The epithet refers to cacao (or *cacaueiro*, as known in Brazil), a plant of interest and historical importance in the agricultural economy of the southern region of Bahia (the area where this

new species of *Passiflora* naturally occurs). Although originally native to the Upper Amazon, near the Ecuadorian–Colombian border on the eastern flanks of the Andes (Cheesman, 1944, as cited in Motomayor et al., 2002), cacao has been cultivated in southern Bahia since the 17th century. The local system for growing cacao, *cabruca*, maintains native vegetation, especially large trees, and is also an important factor in maintaining the biodiversity of other groups of organisms such as birds and insects. During economic downturns in cacao production, most other economic activities in the area have resulted in continued destruction of forests and significant losses of biodiversity. The reference to cacao as the epithet in the name of this new species of *Passiflora* is made in the hopes that less aggressive techniques and more sustainable economic activities, like *cabruca*, can be maintained and developed in the region where this occurs, ensuring the maintenance of this and other species in nature, not only in areas of nature conservation but also in areas of economic development.

Discussion. Species belonging to the *Passiflora* series are close to *P. edulis* Sims, with which the new species is similar, especially in that its plants have membranous, trilobed leaves, with serrated margin, and with the width of the sepal and length of the keel identical. The length of the pedicel of *P. cacao* is within the range observed in *P. edulis* (1.6–6 cm, according to Killip [1938], Cervi [1997], and Bernacci et al. [2003]). Although the lengths do not reach the lower values observed in *P. cacao*, the lengths of the external coronal series, also radial, of *P. edulis* can be smaller, from 1 cm, or larger, to 2.5 cm (Killip, 1938; Cervi, 1997; Bernacci et al., 2003), and the lobes of the leaf's blade may diverge at smaller angles, from 44° or wider up to 120° (Bernacci et al., 2003). *Passiflora cacao*, however, can be easily distinguished by the cylindrical hypanthium and winged seeds. Additionally, *P. edulis* has a flower that is usually larger, 4–7.5 cm in diameter (Killip, 1938; Cervi, 1997; Bernacci et al., 2003), but the number of series in the corona is fewer than those seen in *P. cacao*. Besides the morphological differences observed between *P. cacao* and *P. edulis*, there are also differences in the cytological morphology of pollen, in the length of some chromosomes, in the position of microsatellites, and in the sequence of the *trnL* intron (Viana, 2009).

Passiflora incarnata, also belonging to the series *Passiflora*, is another species with which *P. cacao* has affinities, though the differences occur in a larger set of characters. *Passiflora cacao* has a larger petiole (up to 8 cm) and larger corona external series (1.5–2.5 cm). In *P. incarnata* the lateral lobes can be much longer (5–12 cm) and wider (2–5 cm), the length of the central lobe is relative to the length of the leaf blade (0.75 to 0.8), the peduncle (up to 10 cm) and flowers (sepals and petals 3.2 × 0.8–1 cm and arista 2–4 mm) are larger, while the stipules (2–4 mm), the bracts (4–8 × 2–4 mm, spatulate or oblong, with two glands at the base), and seeds (4–5 × 3–4 mm, and not winged) are smaller (Killip, 1938; Vanderplank, 2000; Ulmer & MacDougal, 2004).

Many species of *Passiflora* have dorsal-ventral flattened seeds, of which those from *P. quadrangularis* L. (subgenus *Passiflora*, supersection *Laurifoliae* (Killip ex Cervi) Feuillet & J. M. MacDougal, series *Quadrangulares* Feuillet & J. M. MacDougal) are the most strongly depressed, being radially striate on the margin (Killip, 1938; Cervi, 1997), as described here for *P. cacao*. However, the margins of *P. quadrangularis* are not so tenuous and thin, not being winged, as they are in *P. cacao*. In *P. filamentosa* Cav. ser. *Passiflora*, the seeds are described as very flat and winged (Killip, 1938; Cervi, 1997). However, this species presents pentalobed leaves and can be easily distinguished from *P. cacao* by other aspects, such as larger flowers (8–10 cm) and peduncles (5–6 cm), larger sepals with a longer awn (to 4–5 cm and 3 mm, respectively), fewer (two) external series in the corona, these being larger (to 2–2.5 cm), and exceeding the perianth.

With the exception of *Passiflora* supersect. *Tacsonia* (Juss.) Feuillet & J. M. MacDougal—in which the hypanthium varies from cylindrical to narrowly cylindrical, and is larger than the sepals—in subgenus *Passiflora*, the hypanthium is usually campanulate, being rarely short cylindrical or narrowly cylindrical, but distinctively smaller or the same length as the sepals (Killip, 1938). *Passiflora* supersect. *Tacsonia* is characterized by its occurrence in the Andes and the presence of long, tubular flowers that are reddish, pinkish, or orangish in color, reflecting a pollination syndrome associated with visits from hummingbirds. However, molecular analysis indicates that this supersection does not correspond to a monophyletic group, it being probable that this pollination syndrome by hummingbirds may have two independent origins within this species group (Hansen et al., 2006). Species of *Passiflora* supersect. *Coccinea* Feuillet & J. M. MacDougal, such as *P. vitifolia* Kunth and *P. speciosa* Gardner, equally present red flowers and are pollinated by hummingbirds. However, the increased size of the nectariferous chamber and accumulated nectar is due rather to the diameter of

the hypanthium, as seen in *P. coccinea* Aubl. (Fischer & Leal, 2006), not because of its length.

In the species of the series *Passiflora*, the length of the hypanthium relative to the length of the sepal is between 0.17 and 0.48 (Bernacci et al., 2003), while as a rule (according to Killip [1938]) this relation is greater than 0.75 for species in section *Tacsonioides* DC. (subgenus *Passiflora*, supersection *Stipulata* Feuillet & J. M. MacDougal, which, however, includes only species with broad, sheetlike, and strongly asymmetric stipules [Feuillet & MacDougal, 2003]). *Passiflora luetzelburgii* Harms, which has a tubular hypanthium and linear stipules (Vitta & Bernacci, 2004), was included in the subgenus *Tacsonioides* (DC.) Killip (Killip, 1938) but is included now in the series *Setaceae* Killip ex Cervi (which typically has species with few series in the corona) of the section *Passiflora* (Ulmer & MacDougal, 2004). *Passiflora luetzelburgii* clashed with the other species in section *Tacsonioides* by stipule characteristics. *Passiflora trintae* Sacco (1968) and *P. farneyi* Pessoa & Cervi (1992) are species accepted for the series *Passiflora* and were recently described. *Passiflora caatingae* L. K. Escobar (1989) was synonymized to *P. trintae* (Cervi, 1995). Including those species previously attributed to *Passiflora* ser. *Serratifoliae* Killip ex Cervi, a total of 13 species have been accepted within *Passiflora* ser. *Passiflora* (MacDougal & Feuillet, 2004; Ulmer & MacDougal, 2004). Therefore, with the description of *P. cacao*, 14 species of the series *Passiflora* are now recognized, of which the majority, nine species, occur natively in Brazil. In all of these, with the exception of *P. recurva* Mast., the margin of the leaf blade varies from serrated to subentire and is only entire in *P. recurva*. The blade margins may sometimes vary within the same species, as in *P. cincinnata* Mast., in which it varies from serrate to crenate-serrate and subentire.

Passiflora trintae has red flowers and an elongated hypanthium (cylindrical and campanulate in shape), which are uncommon characteristics for its series *Passiflora* but similar to *P. luetzelburgii* and *P. racemosa* Brot. (supersection *Stipulata*) in presenting a cylindrical hypanthium and equally red or pinkish-reddish flowers (Killip, 1938; Vitta & Bernacci, 2004). Such characteristics indicate the possibility of pollination by hummingbirds, but these traits could have evolved independently. It is worth highlighting that where *P. cacao* occurs there are reports of many species of hummingbirds (cf. WikiAves, 2008). The elongated hypanthium of the new species could be an indication of its pollination by hummingbirds, although its flowers lack red coloration. Such species as *P. cacao* raise interesting questions about floral biology and phylogenetic relationships, which merit further investigation.

Paratypes. BRAZIL. **Bahia:** Ituberá, Assentamento Lucas Dantas, litoral sul, mata ciliar, 13°43′S, 39°08′W, 3 Sep. 2001 (fr.), *M. L. Guedes, D. L. Santana, D. M. Loureiro & L. J. Alves 9448* (ALCB, CEPEC); Camacan, RPPN Serra Bonita, Mata Atlântica, 10 Dec. 2004 (fl.), *L. C. Bernacci, M. M. Souza, N. E. Pereira, A. S. Maia & V. O. Becker 3898* (IAC); 15°23′01.2″S, 39°34′06.9″W, 10 Dec. 2004 (fl.), *L. C. Bernacci, M. M. Souza, N. E. Pereira, A. S. Maia & V. O. Becker 3900* (IAC), 7 Mar. 2006 (immature fr.), *R. Tsuji, L. C. Bernacci & E. F. Souto 1188* (HPL, IAC). **São Paulo:** cultivated at Nova Odessa, Instituto Plantarum, 19 Jan. 2006 (fl.), *L. C. Bernacci 4105* (IAC, UPCB); 30 Mar. 2007 (fl.), *L. C. Bernacci 4405* (IAC); 10 Mar. 2008 (fl./fr.), *L. C. Bernacci 4492* (IAC); (fl.), *L. C. Bernacci 4494* (IAC, K); 18 Mar. 2008 (fl./fr.), *L. C. Bernacci 4500* (IAC, RB); 6 Mar. 2009 (fl.), *L. C. Bernacci 4677* (HUEFS, IAC).

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Further Nomenclatural Action for the Cypresses (Cupressaceae)

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Abstract. The relationships among cypress species of the closely related genera *Cupressus* L., *Callitropsis* Oerst., and the recently described *Hesperocyparis* Bartel & R. A. Price were examined using morphological characters. Previous studies did not fully resolve New World and Old World cypresses, the status of *Cupressus duclouxiana* B. Hickel, *Cupressus benthamii* Endl., and *Cupressus funebris* Endl. being in question. *Cupressus duclouxiana* is sister to *Hesperocyparis* and *Cupressus benthamii* is sister to *Callitropsis*, while *Cupressus funebris* is considered a basal taxon to all other *Cupressus* investigated. The intrusion of *Hesperocyparis lusitanica* (Mill.) Bartel characters into the standard descriptions of *Cupressus torulosa* D. Don ex Lamb. is examined in order to clarify the differentiation of the respective genera. An emended description of *Callitropsis* constituting a grade of three species is provided. The new combination, *Callitropsis funebris* (Endl.) de Laub. & Husby, is provided for *Cupressus funebris*. Five names at new varietal rank are transferred to *Hesperocyparis*, as *H. arizonica* (Greene) Bartel var. *nevadensis* (Abrams) de Laub. [≡ *Cupressus nevadensis* Abrams], *H. arizonica* var. *montana* (Wiggins) de Laub. [≡ *Cupressus montana* Wiggins], *H. goveniana* (Gordon) Bartel var. *abramsiana* (C. B. Wolf) de Laub. [≡ *Cupressus abramsiana* C. B. Wolf], *H. goveniana* var. *pygmaea* (Lemmon) de Laub. [≡ *Cupressus goveniana* Gordon var. *pygmaea* Lemmon], and *H. lusitanica* var. *lindleyi* (Klotzsch ex Endl.) de Laub. [≡ *Cupressus lindleyi* Klotzch ex Endl.].

Key words: *Callitropsis*, Cupressaceae, *Cupressus*, *Hesperocyparis*.

Three recent publications have divided the species commonly known as cypresses into separate genera. Supported by a large data set based on morphological data, Little (2006) decisively demonstrated that a division would be appropriate and assigned the New World cypresses to the genus *Callitropsis* Oerst. along with the Old World *C. vietnamensis* (Farjon & T. H. Nguyên) D. P. Little [≡ *Xanthocyparis vietnamensis* Farjon & T. H. Nguyên]. Adams et al. (2009), after sampling and analyzing nuclear DNA of several species, concurred with the taxonomic separation but established the new genus *Hesperocyparis* Bartel & R. A. Price to include 16 species of the New World cypresses, with the exception of *C. nootkatensis* (D. Don) Oerst. ex D. P. Little, which was previously handled by Little (2006). Similarly, de Laubenfels (2009) also concurred with Little's (2006) analysis and established the new genus *Neocupressus* de Laub. with eight species and seven varieties. The two synonymous genera, *Hesperocyparis* and *Neocupressus*, were separated in priority by five months, with *Hesperocyparis* the prior name. To finish the taxonomic segregation initiated by Little's (2006) study, several nomenclatural transfers and taxonomic considerations remain for the genus *Hesperocyparis* and are addressed herein.

Since the three genera *Hesperocyparis*, *Cupressus* L., and *Callitropsis* are closely related, relationships among all the component species require examination. Adams et al. (2009) treated every New World cypress taxon at the species rank. While de Laubenfels (2009) suggested that *Cupressus benthamii* Endl. may belong in *Callitropsis*, the analysis of Little (2006) resolved *Cupressus benthamii* with all the other New World species, placing it with them in the genus *Callitropsis*. Adams et al. (2009) did not later attempt to resolve the position of those several species of intermediate morphological characters, including *Cupressus benthamii*. Further, the feasibility of distinguishing New and Old World cypresses cladistically with exclusively morphological characters has not yet been demonstrated.

Morphological data continue to provide useful and reliable phylogenetic resolution (Zander, 2003, 2007b; Lee, 2006) for organismal taxonomies. Morphological character states include important information about organisms that can augment molecular markers used in phylogenetic analyses

(Zander, 2007a; Sotiaux et al., 2009). Thus, complementing molecular studies with morphological data aids in understanding taxonomic relationships. We have examined all 22 relevant cypress species morphologically in great detail, including a series of preliminary cladistic analyses, in order to further resolve the position of all possible species of intermediate character.

Cotyledon characters. A primary uniting character for three basal species in this study, as well as for *Cupressus*, is cotyledon phenology. In *Callitropsis nootkatensis*, *Callitropsis vietnamensis* (Farjon & T. H. Nguyên) D. P. Little, and *Callitropsis funebris* (Endl.) de Laub. & Husby, there are two cotyledons with two additional leaves soon appearing at the same level (suppressed cotyledons), as is the case for all the other Old World cypresses (such as *Cupressus sempervirens* L. and *Cupressus chengiana* S. Y. Hu). *Cupressus benthamii* has multiple cotyledons (not suppressed) as does all of *Hesperocyparis*.

Farjon (2007) took a different interpretation of the cotyledon characters of the cypresses. He argued that two cotyledons do not characterize the Old World cypresses. For *Cupressus chengiana*, Farjon (2005: 191) recorded two to four cotyledons but did not note any frequency of occurrence. Farjon stated that seedling leaves were "initially opposite," implying that two cotyledons are normal. Silba (1983), who grew seedlings of most *Cupressus* species, unequivocally gave two. Farjon (2005) did not mention cotyledon suppression, a unique trait within Cupressaceae (de Laubenfels, 1953). For *Cupressus torulosa* D. Don ex Lamb., Farjon (2005: 224) reported (two)three or four(five) cotyledons; this, as described here, is incorrect. It follows then that Little's (2006) statement that two cotyledons distinguish Old World *Cupressus* should continue to be accepted.

Taxonomic identity of Cupressus torulosa. Discrepancies exist between recent descriptions of *Cupressus torulosa* (Farjon, 2005; Eckenwalder, 2009) and the type specimen. These standard descriptions essentially correspond to *Hesperocyparis lusitanica* (Mill.) Bartel. Both taxa are superficially similar and both occur in northwestern India.

I. Cupressus L., Sp. Pl. 2: 1002. 1753. TYPE: *Cupressus sempervirens* L.

1. Cupressus torulosa D. Don ex Lamb., Descr. Pinus 2: 18. 1824. TYPE: India. "Habitat in India Orientali (Roxburgh) in Bhotaniâ," 1824, *W. S. Webb 6046A* (lectotype, designated by Franco [1968: 189], p.p. [fertile branch], K-00008810).

The name *Cupressus torulosa* was originally applied to cypresses known from northwestern India eastward to central Nepal and possibly further east. The critical characters include the not drooping, distichous branchlets 0.8–1.1 mm wide × 0.8 mm thick that tend to become bunched and can be long and whiplike. The leaves are dimorphic; the laterals have a keel; and the facial has a central pit, the dimorphic character becoming weak with age. Young plants are glaucous, becoming dark green as they mature. The seed cones have eight to 12 bracts, usually 10, are dark brown when mature, and are glaucous when immature. Seedlings have two cotyledons followed at the same level by two alternating leaves and then alternating whorls of four leaves, which is the condition seen in most Cupressaceae.

Overlapping substantially with *Cupressus torulosa* in northwestern India and possibly extending as far as Assam is *Hesperocyparis lusitanica* [≡ *C. lusitanica* Mill.]. Cultivated plants are known across this range, but the native distribution is not clear. The foliage branchlets tend to droop and are not distichous, are 1.2–1.5 mm diam., and are spreading. Leaves are not dimorphic and are strongly keeled and glaucous. The seed cones have six to 10 bracts, usually eight, and are strongly glaucous when immature, becoming less so with age. Seedlings have three to five cotyledons, which is typical for *Hesperocyparis*, in contrast with the closely related *Cupressus* and most of Cupressaceae. *Hesperocyparis lusitanica* is generally thought to have been introduced to India from Mexico many years ago (Farjon, 1993), where, as originally described from Portugal (Miller, 1768: *Cupressus* no. 3), it has also successfully escaped into the wild.

Two problems plagued *Cupressus torulosa* from the very beginning. First, Don (1824: 18) mistakenly attributed the type collection to Bhotan [sic] and called his specimen the "Bhotan Cypress" (*Wallich 6046A* [coll. W. S. Webb in Soorch]). In reality, the collection place was in northwestern India (Franco, 1968), and the mislocation contributed to the confusion of eastern species with *C. torulosa*. The second distraction was the fact that two collections were cited, the second (*Wallich 6046C* [coll. Roxburgh]), which was collected nearby but attributed by Don to eastern India, was a small piece of *Hesperocyparis lusitanica* with an immature seed cone. The fact that Don called his new species the Bhotan Cypress and that the next year he cited only the "Bhotan" specimen in his *Flora Nepalensis* (1825) supports the decision of Franco (1968) to designate it as the lectotype (the fruiting material, not the associated sterile fragment of *Juniperus* L.). No

wonder that Endlicher (1847: 57) indicated "Butan et Nepalia" as the habitat for *C. torulosa*.

Wallich, who assembled the specimens cited by Don, also sent seed the same year that *Cupressus torulosa* was published "in 1824, and again in 1830" (Loudon, 1854: 2479). Soon young plants were under cultivation in Europe. In 1842, Loudon illustrated what is clearly the correct taxon for *C. torulosa*, calling it "[t]he Bhotan, or twisted, Cypress," an error, for *torulosa* does not refer to a twisted form (cf. Loudon, 1854: 2479, figs. 2329–2331; Loudon, 1869: 1076, fig. 2000). More collections of diverse cypresses were rapidly being delivered from India, Nepal, and Bhutan, leading Lindley (1853: 168) to question whether there might be more than one cypress native to India based on differences among the specimens raised in England. He presented an oversized illustration (1853: 167, fig. 105) of a plant cultivated from Himalayan seeds described with glaucous foliage not at all flattened, which clearly identifies this as *Hesperocyparis lusitanica*, although Masters (1896) attributed this to *C. macrocarpa* Hartw. ex Gordon.

Various compilations in the 19th century gave descriptions for *Cupressus torulosa*. Carrière (1855: 118) referred to drooping branchlets, glaucous foliage, and glaucous seed cones, but never mentioned flattening, i.e., *Hesperocyparis lusitanica*. Gordon (1858: 69) also referred to drooping branchlets and glaucous leaves, which suggested *H. lusitanica*. Gordon further referred to *C. torulosa* as the "weeping cypress of travellers," and he noted two cotyledons as well as the "Twisted or Bhotan Cypress." In spite of Lindley's admonition, all Himalayan cypresses were mistaken as similar. Even Camus (1914), who published a monograph on cypresses, repeated the same critical traits as Carrière.

It may seem remarkable that *Cupressus torulosa* and *Hesperocyparis lusitanica* could be so unquestionably combined, but specimens of the two species are, in fact, quite similar. They both have scale leaves and seed cones of about the same size (*C. torulosa* 12–20 × 12–18 mm vs. *H. lusitanica* 12–20 × 12–20 mm). The dimorphism of *C. torulosa* scale leaves on mature specimens is not obvious. Distichous branchlets when pressed require close observation; glaucousness generally disappears on dried specimens, and cotyledons are rarely available. Hill and de Fraine (1908) reported that the cotyledon number is three to five for *C. torulosa*, which is an error, but this was repeated by subsequent authors (Elwes & Henry, 1910; Camus, 1914; Ouden, 1949; Silba, 2005). Because *H. lusitanica* was commonly cultivated under the name *C. torulosa*, the confusion is not surprising.

In 1968, Franco correctly specified the lectotype of *Cupressus torulosa*. He did not give a description of the species but did append a list of the specimens consulted, of which many were, in fact, *Hesperocyparis lusitanica*. Only Shrestha (1974), among modern authors, restricted his brief description to characters appropriate to *C. torulosa*. In treating the *Gymnosperms of Nepal*, Shrestha presumably inspected actual living wild trees.

Farjon (2005: 223) continued the taxonomic confusion in his monograph of the Cupressaceae, describing *Cupressus torulosa* with the branchlets often with drooping ends, the leaves monomorphic, and the cotyledons (two)three or four(five). There is no mention of distichousness, and this description would encompass *Hesperocyparis lusitanica*. Even Eckenwalder (2009: 231), in his recent *Conifers of the World*, treated *C. torulosa* essentially the same as Farjon with characters preponderant for *H. lusitanica*. Finally, the monograph of Silba (2005) would go so far as to treat *C. torulosa* as a subspecies of *H. lusitanica*. However, *C. torulosa* is an important tree in India and Nepal, and the taxon needs careful distinction from *H. lusitanica*.

KEY COUPLET TO DISTINGUISH *CUPRESSUS TORULOSA* AND *HESPEROCYPARIS LUSITANICA*

1a. Branchlets distichous; leaves dimorphic; cotyledons 2; branch ends not drooping .... *Cupressus torulosa*

1b. Branchlets not distichous; leaves monomorphic; cotyledons 3 to 5; branch ends drooping .... *Hesperocyparis lusitanica*

Relationship of Cupressus duclouxiana. The whole of the characters examined resolves *Cupressus duclouxiana* B. Hickel as sister to the eight species analyzed for *Hesperocyparis*. *Cupressus duclouxiana* differs from the Old World *Cupressus* primarily by shoots that are not distichous and foliage that is not dimorphic, in marked contrast to the rest of *Cupressus* (and a large part of Cupressaceae). On the other hand, *C. duclouxiana* does have cotyledon characters like *Callitropsis* that are not found in *Hesperocyparis* but are present in *Cupressus*. This character combination places it with *Juniperus*, which is either sister to a larger cypress group or in a polytomy with cypresses (Little, 2006). This character suite is also shared by *Widdringtonia* Endl., and this genus would likely have a similar position as *Juniperus* had it been included in Little's (2006) analysis. The seed cones of *Juniperus* are more or less fleshy and do not open when mature, and there is usually one wingless seed per fertile bract. The seed cones of *Widdringtonia* are reduced to four bracts, like many of those in

Juniperus, and become warty as they mature. *Cupressus duclouxiana* exhibits intermediate morphology between the Old and New World cypresses. Qualitative characters, such as the suppressed cotyledons that distinguish *C. duclouxiana*, are more significant than quantitative characters. Numbers of cone scales, seeds per scale, pollen sacs per scale, size of cones, and such characters vary, often quite freely, both within and among species or even on individuals of *Cupressus* and many other species. Binary analysis does not distinguish between qualitative and quantitative characters. When a distinctive qualitative character is absent, it may simply have been lost, or displaced by introgression, or even overlooked, as is sometimes the case with anatomical and micromorphological characters. The fact that *C. duclouxiana* has the cotyledon characters of *Cupressus* firmly unites it with that genus. As *C. duclouxiana* has one of the two major characters that distinguish *Cupressus* from *Hesperocyparis*, the conclusion here is that it should not be included within *Hesperocyparis*. Molecular data (Rushforth et al., 2003) and Little's (2006) analysis also support the retention of *C. duclouxiana* in *Cupressus*.

Relationship of Cupressus benthamii. In our morphological cladograms (unpublished), *Cupressus benthamii* does not group with *Hesperocyparis* and is sister to a clade containing *Cupressus* and *Hesperocyparis*. This is consistent with de Laubenfels (2009), who emphasized its dimorphic leaves and distichous shoots that distinguish the taxon from the New World cypresses. Similarly, Little (2006) presented a morphological cladogram that resolved *Callitropsis vietnamensis* as sister to all cypresses and placed *Cupressus funebris*, *Callitropsis nootkatensis*, and *Cupressus benthamii* in a subtending polytomy to a clade containing all other Old and New World cypresses. Nativity to the New World alone is insufficient for inclusion of *Cupressus benthamii* in *Hesperocyparis*, especially because *Callitropsis* is also found in the New World. Related Old World genera with species in the New World include *Thuja* L., *Chamaecyparis* Spath, *Calocedrus* Kurz, *Juniperus*, and *Callitropsis*. In contrast, molecular characters place *Cupressus benthamii* within the New World cypresses (Bartel et al., 2003; Little, 2006). The consistently multiple cotyledons (cotyledons not suppressed) of *Cupressus benthamii*, a key synapomorphy of *Hesperocyparis*, also sets it apart from both *Cupressus* and *Callitropsis*. Nevertheless, the same kind of argument used for *Cupressus duclouxiana* supports placement of *Cupressus benthamii* either in *Cupressus* or *Callitropsis*. Both combinations have already been made.

Relationship of Cupressus funebris. Our morphological studies place *Cupressus funebris* remote from all other cypresses and sister to all other in-group taxa included in the study. Prior studies utilizing molecular characters placed *C. funebris* within the Old World cypresses (Rushforth et al., 2003). There has been a lively discussion concerning its relationship to *Chamaecyparis* (Franco, 1941; Konar & Banerjee, 1963; Gadek & Quinn, 1987; Jagel & Stützel, 2001; Farjon, 2005). *Cupressus funebris* does not belong in *Chamaecyparis*, but shared morphological characters (small deciduous seed cones with few seeds per bract, entire leaf margins, and longer lateral leaves) are also shared with *Callitropsis*. Unlike *Callitropsis*, *Cupressus funebris* resembles *Cupressus* in having three or four pairs of seed cone bracts instead of two or three with the uppermost bracts connate and in having four pollen sacs per scale instead of two or three.

Relationship of Callitropsis. The generic limits of *Callitropsis* have raised questions. Little's (2006) concept of the genus includes all New World cypresses and *C. vietnamensis*. Debreczy et al. (2009) have tentatively argued that *C. nootkatensis* and *C. vietnamensis* might better be treated in separate genera already available. In Little's (2006) molecular and combined analyses, the clade containing those two species is less strongly supported than the clades containing *Cupressus* or *Hesperocyparis*. In Little's (2006) morphological character tree, these two *Callitropsis* species fall outside the *Cupressus* and *Hesperocyparis* clades. The situation is further complicated by the proposal of Mill and Farjon (2006) to conserve *Xanthocyparis* Farjon & Hiep against *Callitropsis*. If strict monophyly is required for all cypresses, one path forward would be simply to erect a new genus for *Cupressus funebris*. However, the three species in question are part of a basal grade to the cypresses, sensu Little (2006). We recommend here that *Cupressus funebris* be included in *Callitropsis* to recognize its distinctive suite of morphological characters that place it close to the already recognized *Callitropsis* species. As noted by de Laubenfels (2009), *Cupressus benthamii* has several characters that ally it to *Callitropsis*, including distichous branchlets, dimorphic leaves, and seed cones with four fertile scales. However, other characters ally it to the New World cypresses and include multiple cotyledons, 10 seeds per scale, and persistent ovulate cone.

The proposed generic circumscription renders *Callitropsis* paraphyletic on a morphological basis. There is an extensive ongoing debate about whether paraphyletic taxa are acceptable in modern system-

atics (Brummitt, 1997; Sosef, 1997; Nordal & Stedje, 2005; Ebach et al., 2006; Zander, 2007c). Evolutionary systematists argue that paraphyly is a natural consequence of evolution and thus should be recognized if systematics is to reflect evolutionary processes (Brummitt, 2006; Farjon, 2007; Zander, 2007b). An argument can also be made on practical grounds that recognition of some paraphyletic groups allows taxonomy to reflect key organismal characters that separate groups with distinctive forms and functions from other members of the same clade. In this case, circumscribing the basal grade of cypress species into *Callitropsis* can recognize their shared characters while avoiding a proliferation of monotypic genera or lumping all cypresses into *Cupressus*, which would be required by strict monophyly using our organismal data. Monophyly is clearly an important criterion to consider in classification but need not be the only consideration. A broad array of analyses and data, including phylogenetic analyses, can inform classification (Hörandl, 2006).

The genus *Callitropsis* has been treated in a number of ways including one, two, or 18 natural species, each treatment potentially generating a distinct generic concept. By recognizing the bulk of the 18 taxa as *Hesperocyparis* (Adams et al., 2009), the following emended generic diagnostic description becomes appropriate.

I. Callitropsis Oerst., Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn, ser. 2, vol. 6: 32. 1864. [1865]. TYPE: *Cupressus nootkatensis* D. Don, Descr. Pinus [Lambert] 2: 18. 1824 [≡ *Callitropsis nootkatensis* (D. Don) Oerst. ex D. P. Little, Syst. Bot. 31(3): 474. 2006].

Branchlets distichous. Cotyledons 2 with 2 additional leaves soon appearing at the same level followed by alternating whorls of 4 linear leaves, which give way to whorls of 3 and then 2 followed by the scale form; leaves scalelike, dimorphic, lateral leaves sharply folded and longer than facial leaves, especially in juvenile specimens; mature leaves strictly acute with a gland present in the groove. Pollen cones with 5 to 7 pairs of bracts. Seed cones with 2 to 4 opposite pairs of bracts (rarely more), 8–12 mm diam., maturing in 2 growing seasons and then opening to shed the seed, not persistent, 2 to 4 seeds on each bract.

Included species (3). *Callitropsis nootkatensis*, *C. vietnamensis*, and *C. funebris*.

Nomenclatural actions for Callitropsis *and* Hesperocyparis. New World cypresses characteristically occur in isolated relict groves, sometimes quite remote. Small differences from one grove to the next can often be detected, leading to the establishment of varieties (Little, 1966, 1970; Bartel, 1993; Eckenwalder, 1993; Farjon, 2005; de Laubenfels, 2009) or subspecies (Murray, 1982; Silba, 2005). Despite limited differences, the New World cypresses have often all been given specific rank (Wolf, 1948; Little, 2006; Bartel in Adams et al., 2009). No varieties have been recognized since the delineation of *Hesperocyparis* Bartel & R. A. Price (in 2009). Herein we establish five requisite varieties. The one species *Cupressus funebris* is transferred herein to *Callitropsis*.

1. Callitropsis funebris (Endl.) de Laub. & Husby, comb. nov. Basionym: *Cupressus funebris* Endl., Syn. Conif., 58. 1847. *Chamaecyparis funebris* (Endl.) Franco, Agros 24: 93. 1941. *Platycyparis funebris* (Endl.) A. V. Bobrov & Melikyan, Komarovia 4: 73. 2006. TYPE: China. Zhejiang (cult.), *G. L. Staunton s.n.* (lectotype, designated by Farjon [2005: 200], BM).

II. Hesperocyparis Bartel & R. A. Price, Phytologia 91(1): 179. [Apr.] 2009. *Neocupressus* de Laub., Novon 19(3): 301. [Sep.] 2009, syn nov. TYPE: *Cupressus macrocarpa* Hartw. ex Gordon [≡ *Hesperocyparis macrocarpa* (Hartw. ex Gordon) Bartel].

1. Hesperocyparis arizonica (Greene) Bartel, Phytologia 91(1): 180. [Apr.] 2009. Basionym: *Cupressus arizonica* Greene, Bull. Torrey Bot. Club 9: 64–65. 1882. *Cupressus benthamii* Endl. var. *arizonica* (Greene) Mast., J. Linn. Soc., Bot. 31: 340. 1896. *Callitropsis arizonica* (Greene) D. P. Little, Syst. Bot. 31: 473. 2006. *Neocupressus arizonica* (Greene) de Laub., Novon 19(3): 302. 2009. TYPE: U.S.A. Arizona: Clifton, on the mtns. back of Clifton, in extreme E part of Arizona, 1 Sep. 1880, *E. L. Greene s.n.* (lectotype, designated by Little [2006: 473], NDG not seen; isolectotypes, K, NA not seen, NY).

1a. Hesperocyparis arizonica (Greene) Bartel var. **arizonica**.

1b. Hesperocyparis arizonica (Greene) Bartel var. **montana** (Wiggins) de Laub., comb. nov. Basionym: *Cupressus montana* Wiggins, Contr. Dudley Herb. 1: 161. 1933. *Cupressus arizonica* Greene var. *montana* (Wiggins) Little, Madroño 18: 163. 1966. *Cupressus arizonica* Greene subsp. *montana* (Wiggins) A. E. Murray, Kalmia 15: 11. 1985. *Callitropsis montana* (Wiggins) D. P. Little, Syst. Bot. 31: 474. 2006. *Hesperocyparis montana* (Wiggins) Bartel, Phytologia

91(1): 182. [Apr.] 2009. *Neocupressus arizonica* (Greene) de Laub. var. *montana* (Wiggins) de Laub., Novon 19(3): 302. [Sep.] 2009. TYPE: Mexico. Baja California: Sierra San Pedro Mártir, La Encantada, 22 Sep. 1930, *I. L. Wiggins & D. Demaree 4990* (holotype, DS; isotypes, F not seen, MEXU not seen, NA not seen, NY [barcode] 00001299, RSA, SD not seen, US-01635428).

1c. Hesperocyparis arizonica (Greene) Bartel var. **nevadensis** (Abrams) de Laub., comb. nov. Basionym: *Cupressus nevadensis* Abrams, Torreya 19: 92. 1919. *Cupressus macnabiana* A. Murray bis var. *nevadensis* (Abrams) Abrams, Ill. Fl. Pacific States 1: 73. 1923. *Cupressus arizonica* Greene var. *nevadensis* (Abrams) Little, Madroño 18: 164. 1966. *Cupressus arizonica* Greene subsp. *nevadensis* (Abrams) A. E. Murray, Kalmia 12: 19. 1982. *Callitropsis nevadensis* (Abrams) D. P. Little, Syst. Bot. 31: 474. 2006. *Neocupressus arizonica* (Greene) de Laub. var. *nevadensis* (Abrams) de Laub., Novon 19(3): 302. 2009. TYPE: U.S.A. California: Kern Co., Piute Mtns., Red Hill near Bodfish, 29 July 1915, *L. Abrams* 5368 (holotype, DS not seen; isotypes, NY, RSA, US).

Key to Varieties of *Hesperocyparis arizonica*

1a. Ovulate cone opens at maturity; seeds strictly non-glaucous ..... var. *montana*
1b. Ovulate cone serotinous; seeds often glaucous 2
2a. Glands on leaves weak or absent ..... var. *arizonica*
2b. Glands on leaves conspicuous and active ..... var. *nevadensis*

2. Hesperocyparis goveniana (Gordon) Bartel, Phytologia 91(1): 181. [Apr.] 2009. Basionym: *Cupressus goveniana* Gordon, J. Hort. Soc. London 4: 295. 1849. *Callitropsis goveniana* (Gordon) D. P. Little, Syst. Bot. 31: 473. 2006. *Neocupressus goveniana* (Gordon) de Laub., Novon 19(3): 303. [Sep.] 2009. TYPE: U.S.A. California: Monterey Co., cultivated from seeds collected by Hartweg in mtns. of Monterey, 2 mi. from sea, 1849, *Anonymous s.n.* (holotype, K).

2a. Hesperocyparis goveniana (Gordon) Bartel var. **goveniana**.

2b. Hesperocyparis goveniana (Gordon) Bartel var. **abramsiana** (C. B. Wolf) de Laub., comb. nov. Basionym: *Cupressus abramsiana* C. B. Wolf, Aliso 1: 215. 1948. *Cupressus goveniana* Gordon var. *abramsiana* (C. B. Wolf) Little, Phytologia 20: 435. 1970. *Cupressus goveniana* Gordon subsp. *abramsiana* (C. B. Wolf) A. E. Murray, Kalmia 12: 19. 1982. *Callitropsis abramsiana* (C. B. Wolf) D. P. Little, Syst. Bot. 31: 473. 2006. *Neocupressus goveniana* (Gordon) de Laub. var. *abramsiana* (C. B. Wolf) de Laub., Novon 19(3): 303. [Sep.] 2009. TYPE: U.S.A. California: Santa Cruz Co., Ben Lomond near Bonnie Doon, 9 Nov. 1934, *C. B. Wolf 6235* (holotype, RSA-352340; isotypes, BH, CAS not seen, DS not seen, GH-22464 digital image, K, MEXU not seen, MO not seen, NA not seen, NY [barcode] 00001288–1290 [3 sheets] digital images, SD-40670 digital image).

2c. Hesperocyparis goveniana (Gordon) Bartel var. **pygmaea** (Lemmon) de Laub., comb. nov. Basionym: *Cupressus goveniana* Gordon var. *pygmaea* Lemmon, Cone-bear. Trees Pacif. Slope, ed. 3: 77. 1895, as "*pigmaea*." *Cupressus pygmaea* (Lemmon) Sarg., Bot. Gaz. 31: 239. 1901. *Cupressus goveniana* Gordon subsp. *pigmaea* (Lemmon) A. Camus, Encycl. Econ. Sylvicult. 2: 50. 1914. *Callitropsis pygmaea* (Lemmon) D. P. Little, Syst. Bot. 31: 474. 2006. *Neocupressus goveniana* (Gordon) de Laub., Novon 19(3): 303. [Sep.] 2009. TYPE: U.S.A. California: Mendocino Co., White Plains, back from the coast, *J. G. Lemmon & wife s.n.* (lectotype, designated by Wolf [1948: 200], UC-185946; isolectotype, DS-164622).

Key to Varieties of *Hesperocyparis goveniana*

1a. Seeds shiny black ..... var. *pygmaea*
1b. Seeds dull brown 2
2a. Seeds not glaucous ..... var. *goveniana*
2b. Seeds usually glaucous ..... var. *abramsiana*

3. Hesperocyparis lusitanica (Mill.) Bartel, Phytologia 91(1): 181. [Apr.] 2009. Basionym: *Cupressus lusitanica* Mill., Gard. Dict., ed. 8, *Cupressus* no. 3. 1768, as "Lusitanica." *Callitropsis lusitanica* (Mill.) D. P. Little, Syst. Bot. 31: 474. 2006. *Neocupressus lusitanica* (Mill.) de Laub., Novon 19(3): 304. [Sep.] 2009. TYPE: Portugal. Cultivated in Herb. Miller, *Anonymous s.n.* (holotype, BM).

3a. Hesperocyparis lusitanica (Mill.) Bartel var. **lusitanica**.

3b. Hesperocyparis lusitanica (Mill.) Bartel var. **lindleyi** (Klotzsch ex Endl.) de Laub., comb. nov. Basionym: *Cupressus lindleyi* Klotzsch ex Endl., Syn. Conif., 59. 1847. *Cupressus lusitanica* Mill. var. *lindleyi* (Klotzsch ex Endl.) Carrière, Traité Gén. Conif., ed. 2: 156. 1867.

Cupressus benthamii Endl. var. *lindleyi* (Klotzsch ex Endl.) Mast., J. Linn. Soc., Bot. 31: 339. 1896. *Hesperocyparis lindleyi* (Klotzsch ex Endl.) Silba, J. Int. Conifer Preserv. Soc. 16(2): 67. [Aug.] 2009. *Neocupressus lusitanica* (Mill.) de Laub. var. *lindleyi* (Klotzsch ex Endl.) de Laub., Novon 19(3): 304. [Sep.] 2009. TYPE: Mexico. Michoacán: betw. Angangueo & Tlalpuxahua, 1839, *C. T. Hartweg 437* (lectotype, designated by de Laubenfels [2009: 304], K; isolectotypes, BM, MO not seen).

Hesperocyparis lindleyi (Klotzsch ex Endl.) Silba subsp. *hondurensis* (Silba) Silba, J. Int. Conifer Preserv. Soc. 16(2): 67. 2009, syn. nov. *Cupressus lusitanica* Mill. var. *hondurensis* Silba, Phytologia 68: 30. 1990. *Cupressus lindleyi* Klotzsch ex Endl. var. *hondurensis* (Silba) Silba, J. Int. Conifer Preserv. Soc. 1(1): 26. 1994. TYPE: Honduras. Intibucá: La Esperanza, *S. D. Enamorado 100* (holotype, NY).

Variety *lindleyi* differs from the type of *Hesperocyparis lusitanica* in the thicker branchlets (1.5–2.1 mm vs. 1.2–1.5 mm) and the larger seed cones (15–23 mm vs. 10–18 mm).

Because *Hesperocyparis* was published before *Neocupressus*, it is necessary to transfer the varieties of various species in *Neocupressus* to be recognized here to the former genus. *Hesperocyparis forbesii* (Jeps.) Bartel and *H. glabra* (Sudw.) Bartel are here accepted as species, and the synonyms of *N. arizonica* var. *glabra* (Greene) de Laub., *Cupressus stephensonii* C. B. Wolf, and *C. arizonica* var. *revealiana* Silba, are therefore considered synonyms of *H. glabra*.

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Systematics and Ecology of a New Species of Seagrass (*Thalassodendron*, Cymodoceaceae) from Southeast African Coasts

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Abstract. Tropical seagrass communities are one of the most productive aquatic ecosystems on earth. A high diversity of seagrass species occurs in southeastern Africa; however, these marine angiosperms are among the least studied in the world. To address this, we have revised *Thalassodendron* Hartog (Cymodoceaceae), one of the most representative seagrasses in these coastal waters. Morpho-anatomical analyses, complemented with field data, reveal that specimens from rocky habitats present a number of distinguishing characters (e.g., rhizome internode lengths, leaf epidermal cells, and flower structures) that recommend their exclusion from the species *T. ciliatum* (Forssk.) Hartog. A new species from rocky habitats, *T. leptocaule* Maria C. Duarte, Bandeira & Romeiras, is thus described and illustrated, with the type from Mozambique, and an identification key for the investigated taxa is presented.

Key words: Coastal waters, Cymodoceaceae, IUCN Red List, seagrass, southeastern Africa, *Thalassodendron*.

Seagrass species are marine angiosperms widely distributed in both tropical and temperate coastal waters, creating one of the most productive aquatic ecosystems on earth (Gullström et al., 2002; Spalding et al., 2003). Seagrass meadows function as shelters and nurseries for juvenile animals. Their canopy acts as a hydrodynamic barrier in near shore areas, and their roots and rhizomes stabilize bottom sediments, providing large benefits for fisheries (e.g., Bandeira, 1995; Gullström et al., 2002; Spalding et al., 2003; Eklöf et al., 2005). Seagrass beds also play an important role in the development of carbonate sediment facies, promoting the settling and stabilization of fine sediment; moreover, seagrass stems and blades provide important habitats for epiphytic marine organisms, such as calcareous faunas and crustose coralline algae, which ultimately contribute skeletal material to the substrate (Perry & Beavington-Penney, 2005).

Although seagrasses provide one of the most important coastal ecosystems, a decline in their distribution and abundance has been observed and is due to a growing coastal population and an overexploitation of resources (e.g., Short & Wyllie-Echeverria, 1996; Barberá et al., 2005). Together with mangroves, coral reefs, and tropical rainforests, seagrass meadows are among the most threatened ecosystems on earth (Waycott et al., 2009). Seagrass meadows and the ecosystems they support are also threatened by natural disturbances and the potential impacts of climate change (Björk et al., 2008). The preservation of these ecosystems and their associated services—in particular, biodiversity, primary and secondary production, nursery habitat, and nutrient and sediment sequestration—should be a global priority (Orth et al., 2006). An ecosystem-based conservation and management strategy is essential to preserve not just seagrasses and their dependent communities, which include several threatened species, but also the entirety of coastal ecosystems (Orth et al., 2006; Hughes et al., 2009).

A high diversity of seagrass species occurs in southeastern Africa, which is recognized as one of the world's most important seagrass areas (Spalding et al., 2003).

An increasing loss of seagrass habitats was reported for southeast African coasts, namely for Mozambique, with ca. 2500 km of coastline. Estimates of seagrass areal coverage in Mozambique point to 439.04 km^2, of which 27.55 km^2 are reported as lost (Bandeira & Gell, 2003). About 12 species occur in this country (Bandeira & Gell, 2003), and diverse taxonomic questions remain to be solved.

Twelve seagrass genera are accepted worldwide: five in Cymodoceaceae (*Amphibolis* C. Agardh, *Cymodocea* K. D. Koenig, *Halodule* Endl., *Syringodium* Kütz., *Thalassodendron* Hartog); three each in Hydrocharitaceae (*Enhalus* Rich., *Halophila* Thouars, *Thalassia* Banks) and Zosteraceae (*Heterozostera* (Setch.) Hartog, *Phyllospadix* Hook., *Zostera* L.); and one in Posidoniaceae (*Posidonia* K. D. Koenig) (den Hartog & Kuo, 2006). Along southeast African coasts, most of the marine angiosperms belong to Cymodoceaceae. According to Tomlinson (1982), this family can be divided into two major groups. The first includes the genera *Cymodocea*, *Halodule*, and *Syringodium*, which are generally characterized by shedding leaf blades, persistent leaf sheaths, stalked anthers, and herbaceous rhizomes with monopodial branching. The second group includes the genera *Thalassodendron* and *Amphibolis* (the latter from the coasts of Australia), which are characterized by leaf blades and sheaths that shed together, subsessile anthers, viviparous reproduction, and woody rhizomes with sympodial branching.

In general, the root morphology that is characteristic of most seagrasses (i.e., an extensive rhizome system with additional anchorage function and dispersal by lateral growth) confines most species to soft-bottom habitats composed mainly of sand or soft substrates with shells or coral debris (den Hartog, 1970; Phillips & Meñez, 1988; Bandeira & Björk, 2001). Despite the fact that most of the Cymodoceaceae genera only occur on unconsolidated substrates, some species can be found in rocky substrates: *Amphibolis antarctica* (Labill.) Asch. and *A. griffithii* (J. M. Black) Hartog can be found along warm-temperate west and south Australian coasts, and *Thalassodendron pachyrhizum* Hartog can be found along warm-temperate west and southwest Australian coasts (den Hartog, 1970; Kuo & McComb, 1998; Short et al., 2001). The widespread *T. ciliatum* (Forssk.) Hartog, which occurs along tropical and subtropical coasts from the Red Sea eastward to the Asiatic coasts of the Pacific and the north Australian coasts, and southward along the east African coasts, has been reported from both sandy and rocky habitats (Phillips & Meñez, 1988).

Morphological differences between southeast African *Thalassodendron ciliatum* populations in sandy and rocky habitats have been observed by several authors. Obermeyer (1966) compared populations from sheltered, warm coral reefs without wave action with populations from colder waters of sandstone rock crevices exposed to waves that are characteristic of south African habitats. The author observed that these specimens presented gnarled rhizomes, flexible stems, and thinner, narrower leaves, which were absent in populations from sandy substrates. In addition, Bandeira's studies (2002a, 2002b) on populations of *T. ciliatum* from rocky habitats with a very strong water current along southern coasts of Mozambique described morphological traits similar to those previously reported by Obermeyer (1966), e.g., thinner stems, fewer and narrower leaves, and shorter and more condensed internodes than specimens from sandy substrates. Furthermore, in rocky substrate specimens, the growth rate dynamics were quite different, with higher growth rates per unit area; an increase in leaf length and biomass per unit area was also higher in such plants (Bandeira, 2002b). High density of shoots per unit area in rocky habitats prompted these differences.

The morphological distinction between the *Thalassodendron ciliatum* specimens from sandy and rocky habitats relied on the vegetative structures, since reproductive specimens were only known in populations from sandy habitats in Mozambique (Bandeira & Nilsson, 2001; Bandeira, 2002b). Rocky and sandy populations were observed and sampled during the fieldwork performed in Mozambique, and for the first time (at the end of 2008) it was possible to collect individuals from rocky habitats with female reproductive structures. The extreme rarity of reproductive structures among *Thalassodendron* specimens from rocky habitats, confirmed within the context of studies on Cymodoceaceae for *Flora Zambesiaca* (Duarte, 2009), probably explains the current merging of rocky and sandy habitat specimens within the same taxon, though the differences in the morphological and physiological features between them are evident. The combination of morpho-anatomical analyses with field data presented here supports the recognition of two taxa within *Thalassodendron* specimens from southeast African coasts: *T. ciliatum* and *T. leptocaule* Maria C. Duarte, Bandeira & Romeiras.

Thalassodendron leptocaule Maria C. Duarte, Bandeira & Romeiras, sp. nov. TYPE: Mozam-

bique. Maputo: Matutuíne, Ponta do Ouro, 28 Nov. 2008 (♀), *M. C. Duarte & A. M. Manjate 3801* (holotype, LISC; isotypes, LMU, MO). Figures 1, 2.

Haec species *Thalassodendro ciliato* (Forssk.) Hartog affinis, sed ab eo rhizomate usque ad 3 mm diametro, internodiis (0.5)1–6 mm longis, foliis lamina 3–9 cm longa et 3–7 mm lata, epidermidis cellulis pariete anticlinali flexuoso, floribus masculinis in bractea solitaria foliosa inclusis atque floribus femineis in bracteis 3 foliaceis inclusis differt.

Perennial, dioecious seagrass; rhizomes with sympodial branching, brown, terete, gnarled, to 3 mm diam.; vertical rhizomes rare; roots usually much branched, 2 at the stem-bearing internode (4th), 2 at the preceding internode (3rd), and none at the 1st and 2nd internodes; internodes much condensed (0.5–)1–6 mm. Scales ca. 5 mm, broadly ovate, early deciduous, dark brown; apex obtuse and apiculate; stems erect, 1(2), unbranched or little branched, to 70 cm, 1–2 mm width, with 4 or 5(6) leaves per shoot; leaf sheaths 10–30 × 3–9 mm, cuneate at the base, cream at the base becoming greenish (similar to leaf blade) to the top, with obtuse auricules, caducous, leaving circular scars irregularly spaced, to 10 mm apart; tanniniferous cells usually inconspicuous, margins scarious; ligule obtuse, 0.5–0.75 mm high; leaf blade usually falcate, 3–9 × 0.3–0.7 cm, greenish brown in dried condition; distal margins irregularly serrulate; veins (7)11 to 15(17), united below leaf apex; median and lateral veins slightly prominent; 15 to 23 rows of cells between secondary veins; leaf epidermis cells elongate and rectangular with anticlinal walls sinuous in surface view; leaf apex obtuse, slightly emarginate, denticulate, except at the middle zone; apical teeth to 0.5 mm high, acute or truncate. Squamules in leaf axils in 2 opposite groups of (1)2 to 4 squamules each, of unequal size, the longer about 0.75–2 mm. Male and female flowers solitary on short lateral shoots near the base of leaf clusters. Male flower enclosed in a leafy bract, sessile; anthers ca. 2.5 mm, 2 dorsally connate over entire length and attached at the same height with a short terminal appendage (ca. 0.5 mm), entire. Female flower enclosed in 3 leafy bracts, all differentiated into a sheath and a blade, with a ligule 0.5–0.75 mm; 1st bract outermost with a sheath 13–15 mm, the blade slightly smaller; 2nd bract with a sheath ca. 16–22 mm, the blade slightly shorter or longer; 3rd bract 14–20 mm, the blade equal to or longer, slightly falcate with the apex acute, obscurely veined, somewhat fleshy; ovary ellipsoid, 1.5–2 mm; style divided into 2 stigmatic arms 12–16 mm, strap-shaped. Seedlings viviparous.

Distribution and habitat. According to current data, *Thalassodendron leptocaule* occurs in southeast African tropical coastal areas from Xai-Xai (Gaza Province) and Ponta do Ouro (Maputo Province, type locality) in southern Mozambique, extending to Boteler Point (KwaZulu-Natal Province) in South Africa. Field observations (S. O. Bandeira) indicate the presence of the taxa in Chidenguele (70 km north of Xai-Xai) and north to Inhambane Province in Mozambique. *Thalassodendron leptocaule* occurs from the intertidal area to the subtidal fringe, usually in rocky pools, in crevices and creeks, and on calcareous sandstone, and is exposed to severe wave action. The species occurs in habitats that are permanently submerged or partially exposed at low water to ordinary spring tides (whereas *T. ciliatum* occurs from the lower intertidal to subtidal areas and always occurs with residual water or is submerged), and water temperature in the distribution area ranges between ca. 27°C (at Maputo latitude) and 26°C in the south (at Richards Bay latitude) during the warmest month (February). This species forms dense communities and is usually associated with seaweeds. Unlike *T. ciliatum*, the presence of epiphytic seaweeds along the stems is very rare. As in *T. ciliatum*, calcareous encrusters, such as crustose coralline algae and epiphytic fauna (Perry & Beavington-Penney, 2005), in stems and especially in leaves are common although much more expressive—512 g/m^2 versus 40 g/m^2 are referred (Bandeira, 2002b) to *Thalassodendron* plants in rocky and sandy habitats, respectively.

IUCN Red List category. Data on population size, structure, trend, and range for *Thalassodendron leptocaule* are insufficient, and only a conservation assessment of Data Deficient (DD; IUCN, 2001) can be made following the IUCN Standards and Petitions Subcommittee (2010). However, it should be noted that the particular habitat of this species is very limited along southeast African coasts and may be affected by threads, such as siltation, and continued growth of tourism infrastructures and activity in coastal areas.

Phenology. The flowering specimens of *Thalassodendron leptocaule* were gathered in October and November.

Etymology. The specific epithet *leptocaule* is from Latin and refers to the long and slender stems of *Thalassodendron leptocaule*.

Discussion. As summarized in Table 1, the *Thalassodendron ciliatum* specimens from sandy habitats

Figure 1. *Thalassodendron leptocaule* Maria C. Duarte, Bandeira & Romeiras. —A. Community of *T. leptocaule* and seaweeds in rocky pools, Inhaca Island, Ponta Mazónduè, Mozambique. —B. Flowering shoot with viviparous seedling (arrow). —C. Inner bract enclosing the female flower in fresh specimen. —D. Inner bract enclosing the female flower (*M. C. Duarte & A. M. Manjate 3801*, LISC). Scale bars: B = 15 mm; C, D = 5 mm.

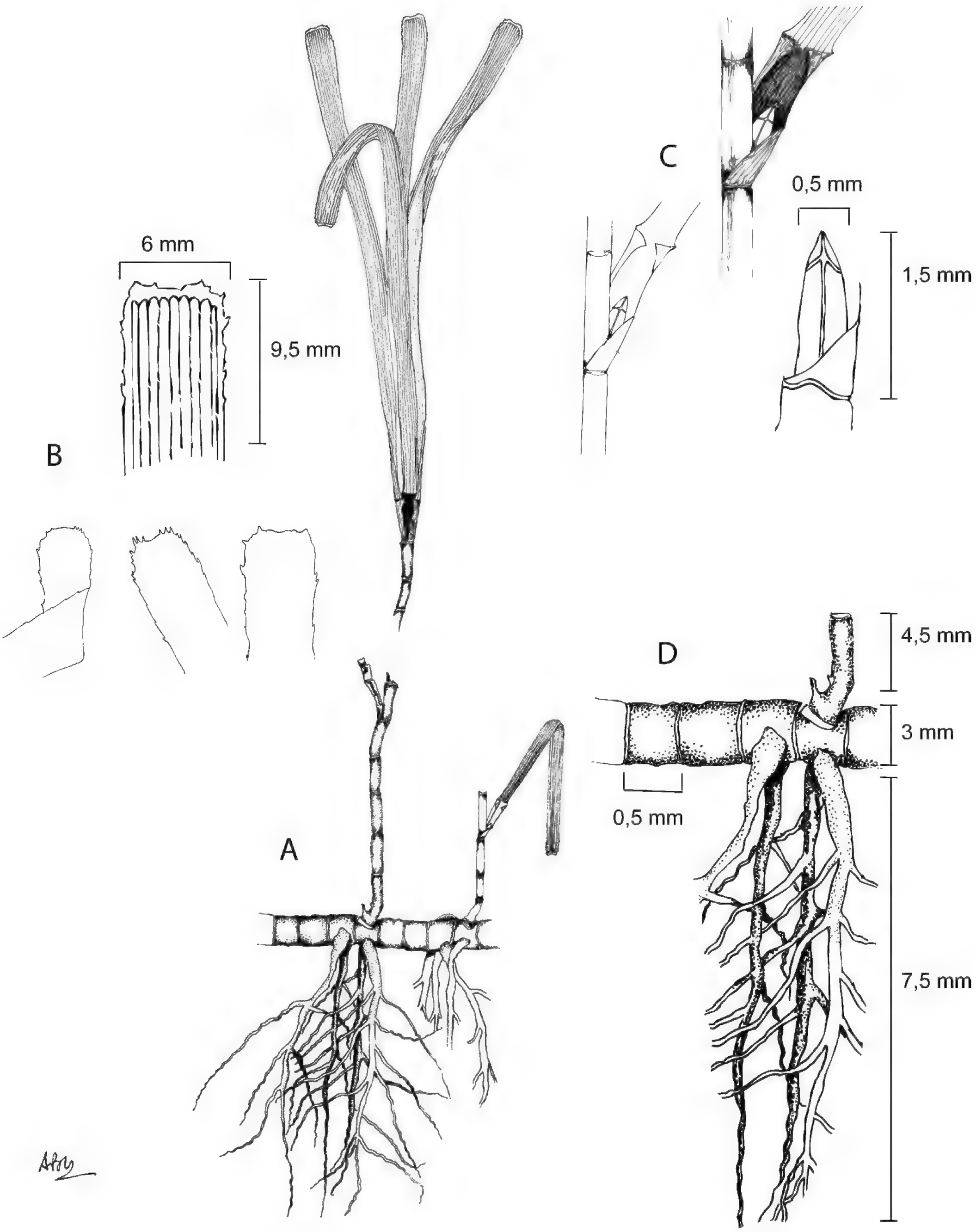

Figure 2. *Thalassodendron leptocaule* Maria C. Duarte, Bandeira & Romeiras. —A. Habit. —B. Leaf apices. —C. Male flower. —D. Rhizome. A, D drawn from *Ward 9052* (K); B, C from *Mauve & Verdoorn 71* (BM).

are distinctly different from *T. leptocaule* specimens from rocky habitats. Morpho-anatomical analyses indicated that leaf epidermal cells (either on adaxial or abaxial surfaces) are somewhat isodiametric or rectangular with straight anticlinal walls in *T. ciliatum* (Fig. 3A) and rectangular with sinuous anticlinal walls in *T. leptocaule* (Fig. 3B) (a character also present in *Amphibolis*). The male flower in *T. ciliatum* is protected by four bracts rather than one, as is the case in *T. leptocaule*; anthers from *T. ciliatum* are considerably longer, 6–10 mm versus ca. 2.5 mm (Fig. 3C, D). The only male specimen known of *T.*

Table 1. Ecological and morpho-anatomical comparison between *Thalassodendron ciliatum* (Forssk.) Hartog (sensu Duarte, 2009) and *T. leptocaule* Maria C. Duarte, Bandeira & Romeiras; 73 specimens (housed in BM, K, LISC, LMU, PRE, and SRGH), 33 from rocky habitats and 40 from sandy habitats, were examined. Data concerning substrate type (rocky and sandy) were taken from herbarium labels.

Character	*T. ciliatum*	*T. leptocaule*
Substrate	sandy	rocky
Rhizomes	reddish brown, angled, to 8 mm diam.; with vertical rhizomes; internodes 0.5–3 cm	brown, terete, to 3 mm diam.; vertical rhizomes rare; internodes (0.05–)0.1–0.6 cm
Roots	little or much branched; root hairs common; roots to 10 at the stem-bearing internode (4th) and at the preceding internode (3rd), none at the 1st and 2nd internodes	usually much branched; root hairs rare; roots 2 at the stem-bearing internode (4th), 2 at the preceding internode (3rd), and none at the 1st and 2nd internodes
Stems	to 35 cm long, 1.5–3.5(−4) mm wide	to 70 cm long, 1–2 mm wide
Leaf scars	to 20 mm apart at the base; the upper successively closer to 1–2 mm apart	irregularly spaced, to 10 mm apart
Ligule	obtuse, 1–1.5 mm high	obtuse, 0.5–0.75 mm high
Leaves	(5)6 to 8(9) per shoot, 5–15 cm long, 5–14 mm wide; blade margins serrulate	4 or 5(6) per shoot, 3–9 cm long, 3–7 mm wide; blade margins ± serrulate
Leaf apex	obtuse, slightly emarginate, denticulate; apical teeth to 0.5–1 mm high	obtuse, slightly emarginate, denticulate, except at the middle zone; apical teeth to 0.5 mm high
Leaf epidermal cells (in surface view)	somewhat isodiametric or rectangular; anticlinal walls straight; 25 to 35(40) cell rows between secondary veins	rectangular; anticlinal walls sinuous; 15 to 23 cell rows between secondary veins
Leaf veins	5 to 29	(7)11 to 15(17)
Flower arrangement	on short lateral shoots near the base of leaf clusters	on short lateral shoots near the base of leaf clusters
Flower structure	flowers (male and female) enclosed by 4 leafy bracts	flowers enclosed by 1 (male) or 3 (female) leafy bracts
Female flower	style divided into 2 slender, stigmatic arms 20–30 mm; apex of the inner bract (4th bract) obtuse	style divided into 2 stigmatic arms 12–16 mm; apex of the inner bract (3rd bract) acute
Male flower	2 anthers dorsally connate over entire length and attached at the same height; anthers 6–10 mm, with a short terminal appendage, sometimes bilobed	2 anthers dorsally connate over entire length and attached at the same height; anthers ca. 2.5 mm, with a short terminal appendage, entire

leptocaule (*Mauve & Verdoorn 71*, BM) was carefully examined to put forward the hypothesis that eventual bracts could leave scars from shedding, though the material was not dissected to avoid damage to the specimen. The female flower in *T. ciliatum* is enclosed by four bracts (the inner one without a ligule and with the apex obtuse), whereas in *T. leptocaule*, it is enclosed by three bracts (the inner one with a ligule and with the apex acute, see Fig. 1C, D). Common characteristics for both species include the presence of a woody rhizome with sympodial branching and woody roots with stems arising at every fourth internode. The leaf blade and sheath shed simultaneously; anthers are connate over their whole length; and viviparous seedlings are present.

It has to be noted that some of the morphological characters used to distinguish the two *Thalassodendron* taxa (see Table 1) are also useful taxonomic characters for distinguishing other seagrass species, e.g., the organization of the rhizomes and variation in the erect shoots (Posluszny & Tomlinson, 1991) or the shape of epidermal cells (Kuo & Stewart, 1995; Kuo & den Hartog, 2006). In effect, features of the epidermis are useful characters in systematic botany (Stace, 1980), and as stated in a recent study by Liu and Zhu (2009), the shape of epidermal cells and the pattern of anticlinal walls are variable in different taxa but consistent within the same taxon.

Bandeira and Nilsson (2001) performed a genetic study of population based on random amplification of polymorphic DNA (RAPD) markers that found scarce differences among sandy and rocky populations of *Thalassodendron* specimens from southern Mozambique. However, this study was based on an insufficient number of random primers and was not conclusive to generate the genomic fingerprint distinctive for *Thalassodendron* species.

Furthermore, the genetic analyses of other seagrass genera were inconclusive. Genetic data from specimens of *Zostera marina* L., *Z. asiatica* Miki, and *Z.*

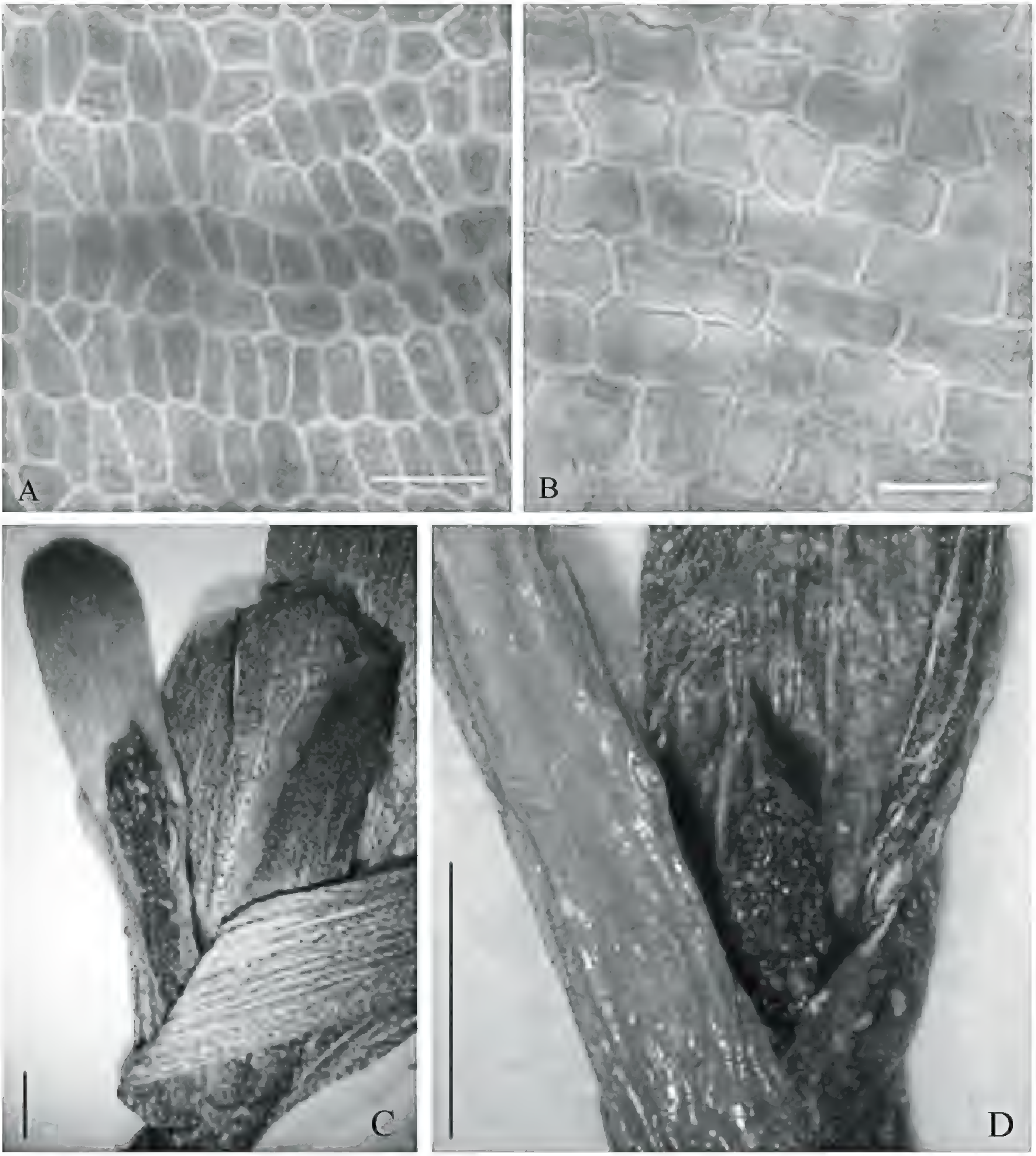

Figure 3. A, B. Comparison of leaf epidermis cells. —A. *Thalassodendron ciliatum* (Forssk.) Hartog, the leaf epidermis showing isodiametric or rectangular cells with straight anticlinal walls (*Mogg 35185*, LISC). —B. *T. leptocaule* Maria C. Duarte, Bandeira & Romeiras, the leaf epidermis revealing elongate, rectangular cells with sinuous anticlinal walls (*Mogg 31525*, LISC). C, D. Comparison of stamens. —C. *T. ciliatum* (*Moss 20794*, K; reproduced with kind permission of the Board of Trustees of the Royal Botanic Gardens, Kew). —D. *T. leptocaule* (*Mauve & Verdoorn 71*, BM; reproduced with kind permission of the Head of Collections of the Department of Botany of the Natural History Museum, London). Scale bars: A, B = 25 μm; C, D = 2 mm.

japonica Asch. & Graebn. from Pacific coasts of North America and Asia (Japan) revealed species boundaries that were not congruent with morphological traits (Talbot et al., 2006), recommending integrative taxonomic studies.

Some hypotheses may explain the discrepancy between genetic and morphological analyses, namely, phenotypic plasticity, morphological convergence, or interspecific hybridization. Presently, DNA barcoding is well suited to address species identification quickly and accurately for many plant groups, although the two regions of plastid DNA (*matK* and *rbcL*) that have been selected (CBOL Plant Working Group, 2009) as such plant barcodes have revealed relatively few differences between the barcodes for closely related species. Therefore, it is expected that

in the near future, the use of other DNA regions (e.g., nuclear low-copy genes) should permit the identification of hybrids and also overcome the lower levels of discrimination, providing a more comprehensive picture of seagrass evolution.

Despite some taxonomic controversies associated with the relationships within seagrass species, it is suggested that *Thalassodendron* species are undergoing an adaptive radiation in southeast African coasts, driven in part by local adaptation to the ecological heterogeneity of soils. In conclusion, the morphological and anatomical analyses presented in this paper highlight the fact that the seagrass populations of sandy habitats (*T. ciliatum*: see Fig. 3A, C) are well differentiated from the populations of rocky habitats (*T. leptocaule*: see Figs. 1, 3B, D).

Key to *Thalassodendron* Species in Southeast Africa

1a. Rhizomes to 8 mm diam.; internodes 0.5–3 cm long; stems 1.5–3.5(–4) mm wide; leaves (5)6 to 8(9) per shoot, 5–15 cm long, 5–14 mm wide; epidermal cells with straight anticlinal walls ..... *T. ciliatum*

1b. Rhizomes to 3 mm diam.; internodes (0.05–)0.1–0.6 cm long; stems 1–2 mm wide; leaves 4 or 5(6) per shoot, 3–9 cm long, 3–7 mm wide; epidermal cells with sinuous anticlinal walls ..... *T. leptocaule*

Paratypes. MOZAMBIQUE. **Maputo:** Matutuíne, Inhaca Island, 30 Oct. 1962 (♂), *Mauve & Verdoorn 71* (BM); 23 mi. E of Maputo, 20 July 1956, *Mogg 31525* (BM, K, LISC, PRE, SRGH). SOUTH AFRICA. **KwaZulu-Natal:** Hlabisa, 2.9 km N of Boteler Point, 22 Oct. 1976, *Ward 9052* (K, PRE).

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A New Species of *Pseudostellaria* (Caryophyllaceae) from Korea

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ABSTRACT. *Pseudostellaria longipedicellata* S. Lee, K. Heo & S. C. Kim is newly described from the Taebaek Mountain Range across three eastern provinces (i.e., Gangwon, Chungcheongbuk, and Gyeongsangbuk) of the Korean Peninsula. *Pseudostellaria longipedicellata* is similar to *P. palibiniana* (Takeda) Ohwi by having an open flower, glabrous pedicel, and slender taproots, but differs by its shorter, decumbent, and slender stems, oblanceolate leaves distally changing to elliptic or narrowly ovate, and the fertile pedicel that elongates to the ground when bearing fruit. A dichotomous key to the Korean species of *Pseudostellaria* Pax is provided in this paper. Also discussed are the major differences of *P. longipedicellata* from its congeners, and the new species' possible pollination and dispersal mechanisms.

Key words: Ant pollination, Caryophyllaceae, cleistogamy, IUCN Red List, *Pseudostellaria*.

Pseudostellaria Pax (Caryophyllaceae) refers to the genus of false chickweeds or stitchworts with about 21 species found in temperate regions. The greatest species diversity is in Asia, with 17 species; a single species is known from Europe; and three species are described from North America (Ohwi, 1937; Mabberley, 2008). The number of *Pseudostellaria* species distributed on the Korean Peninsula varies from five species (Chung, 1957), six species (Lee, 1979), or nine species (Ohwi, 1937; Lee, 1996; Lee, 1998) according to the checklists or floras. Choi (1993, 1999) extensively reviewed the genus in Korea and recognized the reported taxa as six species, with two new hybrids. The genus is distinguished by its fusiform tubers, with both chasmogamous and cleistogamous flowers (Flora of China online, 2008).

During fieldwork, a putative new species from Mt. Taebaek Provincial Park was originally encountered and reported (Lee, 1997, as nom. nud.). This new taxon appeared similar to *Pseudostellaria palibiniana* (Takeda) Ohwi, sharing the subverticillate, distalmost leaves, fasciculate tubers, glabrous pedicels, and solitary and terminal flowers (Ohwi, 1937; Choi, 1993; Lee, 1997); however, the new species, *P. longipedicellata* S. Lee, K. Heo & S. C. Kim, validly described herein differs from *P. palibiniana* in many quantitative vegetative and floral characters (Table 1), and it significantly differs from its congeners in its stem and leaf shape and pedicel length. The stems of *P. palibiniana* (13.5 ± 3.3 cm) are erect and robust, generally taller than those of *P. longipedicellata* (9.2 ± 2.1 cm), which are basally decumbent and slender. The four distalmost leaves of *P. palibiniana* are narrowly ovate to elliptic, but are noted as ovate after anthesis; these leaves in *P. longipedicellata* are oblanceolate or lanceolate, but are post-anthesally observed as elliptic or narrowly ovate. The fruiting pedicel of *P. palibiniana* does elongate, but not as extensively as was observed for *P. longipedicellata*, where the pedicel elongates until reaching the ground (Figs. 1, 2).

Pseudostellaria longipedicellata S. Lee, K. Heo & S. C. Kim, sp. nov. *Pseudostellaria pendula* S. Lee, nom. nud. A Key to the Vascular Plants of Korea, 170–171. 1997. TYPE: Korea. Gangwon: Mt. Taebaek, under larch forest near S entrance of Mt. Taebaek Provincial Park, 1 June 1996, *S. T. Lee s.n.* (holotype, SKK; isotypes, MO, SKK). Figures 1–3.

Species nova *Pseudostellariae palibinianae* (Takeda) Ohwi affinis, sed ab ea foliis apicalibus primum oblanceolatis vel lanceolatis post anthesin ellipticis vel anguste ovatis atque pedicello in fructu deorsum extenso humum attingente distinguitur.

Perennial herbs; rhizomatous with 3 to 20 aerial stems; taproots 1 to 4, with slender and fusiform tubers, 5–13.5 × 0.14–0.25 cm; stems basally decumbent, slender, 6–14 cm, with 1 or 2 vertical rows of trichomes. Proximal leaves oblanceolate or spatulate, pubescent along proximal margin, 1.2–3 × 0.3–0.6 cm; middle leaves similar but 1.8–4.2 × 0.3–0.7 cm; distalmost leaves oblanceolate or lanceolate, subverticillate; with 4 ± whorled, the 2 larger ones 2–3.9 × 0.4–1.3 cm, the other 2 markedly smaller, nearly sessile, pubescent along proximal margin; whorled leaves change to elliptic or narrowly ovate. Flowers solitary and terminal; pedicels 3.1–4.8 cm, glabrous or rarely basally pubescent, post-anthesally elongating 3.8–6.9 cm until reaching the ground. Sepals 6 to 9, lanceolate, glabrous, margin membra-

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Table 1. Morphological comparison of *Pseudostellaria palibiniana* (Takeda) Ohwi and *P. longipedicellata* S. Lee, K. Heo & S. C. Kim. The values obtained in this study were measured from 16 specimens (minimum – means ± standard deviation – maximum).

Characters	*P. palibiniana*	*P. longipedicellata*
Petal number	5–6.3 ± 0.63–7*	6–6.7 ± 0.78–9
Petal length (mm)	4.5–5.9 ± 0.71–7.2*	2.9–4.5 ± 0.68–5.4
Petal width (mm)	1–1.5 ± 0.26–2*	1–1.5 ± 0.3–2
Sepal length (mm)	3.5–5.5 ± 1.16–7.8*	3.6–4.3 ± 0.49–5.1
Sepal width (mm)	0.8–1.2 ± 0.24–1.8*	0.7–1.3 ± 0.27–1.8
Style number	2–3.6 ± 0.76–5*	3–3.42 ± 0.51–4
Stem length (cm)	7.3–13.5 ± 3.3–19.5	6–9.2 ± 2.05–14
Pedicel length (cm)	1.8–2.4 ± 0.3–2.8	3.1–4.1 ± 0.52–4.8
Fruit pedicel length (cm)	1.8–2.6 ± 0.5–3.7	3.8–5.5 ± 0.88–6.9
Distalmost subverticillate whole leaf length (cm)	1.9–3.7 ± 0.7–5	2–2.8 ± 0.59–3.9
Distalmost subverticillate whole leaf width (cm)	0.6–1.1 ± 0.41–2	0.4–0.7 ± 0.3–1.3
Distalmost subverticillate whole leaf length (L) and width (W) ratio (L/W)	2–3.7 ± 1.47–7.1	2.7–4.4 ± 1.14–7.1
Mature distalmost subverticillate whole leaf length (cm)	2.7–5.5 ± 1.54–9.9	3.1–4.7 ± 1.21–8.6
Mature distalmost subverticillate whole leaf width (cm)	1.1–2.5 ± 0.72–4.6	0.6–2 ± 0.81–4.6
Mature distalmost subverticillate whole leaf length (L) and width (W) ratio (L/W)	1.7–2.2 ± 0.32–3.1	1.8–2.6 ± 0.69–4.9

* Values marked with asterisks were adapted from Choi (1999). Vouchers for *P. palibiniana* include *S. Kim s.n.* (SKK-19960427001), *H. Kim s.n.* (SKK-19960428001), *S. T. Lee s.n.* (SKK-20070503001), *D. Jo s.n.* (SKK-19950603001), *K. Heo & J. Goh HKI050013* (SKK), *S. T. Lee & K. Heo HKI050015* (SKK), *S. T. Lee & K. Heo S.Lee050010* (SKK), *K. Heo et al. HKI050030* (SKK), *K. Heo et al. HKI20070427001* (SKK), *K. Choi 234* (KNU), *K. Choi 26* (KNU), *J. H. Park 4026* (KNU), *J. H. Park 5536* (KNU), *Y. Wong et al. s.n.* (KNU-00000143), *S. W. Park et al. 80* (KNU), *K. Choi et al. 8* (KNU), *S. A. Lee 2* (KNU), *S. Y. Choi s.n.* (KNU-00012050), *Y. J. Jo s.n.* (KNU-00012046), *J. H. Park s.n.* (KNU-00012057), *J. H. Park et al. 3570* (KNU), and *J. H. Park 3672* (KNU).

nous, 3.6–5.1 × 0.7–1.8 mm; petals 6 to 9, obovate, apex acute, emarginate, obtuse, or round, white, 2.9–5.4 × 1–2 mm; stamens 12, filaments 3.1–4.4 mm, anthers 0.5–0.6 mm; ovaries syncarpous, with 3 to 4 carpels, ovate, 1.3–2.8 × 1.3–2.6 mm, style distinct, 2–3.7 mm, stigma filiform to clavate. Fruit as capsule, reddish brown, septicidally dehiscent; seeds (4 to)9(to 15), reniform, 1.8–2.6 × 1.7–2.2 mm, papillose, the papillae distributed evenly, roundly conical, their anticlinal cell walls branching radially and irregularly, tightly interwoven with other cell walls, the spinules of papilla slender, 0.02–0.03 mm.

Phenology. *Pseudostellaria longipedicellata* was observed to flower in April with fruiting from May to June.

Distribution. *Pseudostellaria longipedicellata* is endemic to Mts. Taebaek, Daedeok, Deokhang, and Myeon in Gangwon Province, Korea. It was also collected from Mts. Worak and Joryeong in Chungcheongbuk Province and Mt. Naeyeon in Gyeongsangbuk Province and Mt. Biseul in Daegu Metropolitan City.

IUCN Red List category. *Pseudostellaria longipedicellata* is native to three eastern provinces, i.e., Gangwon, Chungcheongbuk, and Gyeongsangbuk, as well as Daegu Metropolitan City on the Korean Peninsula. Additional populations likely exist along the Taebaek Mountain Range, a north- to south-trending belt running along the eastern margin of the Korean Peninsula. The population size is small (usually less than 100 individuals per population) and several such small populations are sporadic in each locality (or mountain). Populations are typically found in mid to lower elevations of mountains, especially along the hiking trails or park entrances. Recently, some populations, including the type locality, have been threatened and have declined due to construction of some park structures, such as buildings and parking lots. It is urgent to take additional ecological and biological study for effective conservation measures. We recommend an IUCN Red List category of Endangered, with small or declining populations (EN, C2) (IUCN, 2001).

Ecology and phenology. *Pseudostellaria longipedicellata* is sympatric with *P. setulosa* Ohwi, occurring along roadsides, and may be found on somewhat dry leaf mold in larch forests (*Larix* Mill.) near the south entrance of Mt. Taebaek National Park. Its flowering time overlaps with that of *P. setulosa*, beginning in April. Only a few individuals (approximately up to 50 with varying distances from a few centimeters to 1–2 m) of *P. longipedicellata* were observed and these small populations were sporadic. In contrast, the sympatric species *P. setulosa* grew extensively and continuously from its rhizomes. Few individuals of the new species were encountered at locations other than the type locality. *Pseudostellaria*

longipedicellata was noted along roadsides on nearby Mt. Myeon in Gangwon; it was also seen at dry, sunny sites in rocky places in Mt. Worak National Park in Chungcheongbuk Province. Through examination of specimens in other herbaria, the distribution of the described species extended further south to Mt. Naeyeon as well as in Daegu Metropolitan City and Gyeongsangbuk Province.

Etymology. The specific epithet *longipedicellata* highlights the dramatic elongation of the fertile pedicels post-anthesally.

Common name. Tae-baek-gae-byeol-ggot (Korean). The vernacular name Taebaek was taken from the type locality, in Mt. Taebaek National Park.

Discussion. *Pseudostellaria longipedicellata* also appears to be closely related to *P. okamotoi* Ohwi, endemic to Mt. Jiri in Gyeongsangnam Province. However, *P. okamotoi* is easily distinguished from *P. longipedicellata* by having puberulent pedicels (Ohwi, 1937). Interestingly, both species share the intriguing elongation of the fruiting pedicels. Pedicels in *P. okamotoi* elongate (2.3–3.8 cm, sensu Choi, 1993) and bend downward (Choi, 1993), but not to the extent observed for *P. longipedicellata* (3.8–6.9 cm).

Pseudostellaria heterophylla (Miq.) Pax, which occurs widely in the entire Korean Peninsula, is also similar to the new species, sharing four ± whorled distalmost leaves and their shapes. Differences in *P. heterophylla* include more flowers at stem apices (one to eight vs. one in *P. longipedicellata*), only a single taproot (vs. one to four), and leaf blades that are basally ciliate/pubescent (vs. pubescent along the proximal margin in *P. longipedicellata*). Pedicels of *P. heterophylla* are shorter (5.8–28.5 mm) and lack the dramatic elongation seen in the new species (Choi, 1993).

The surface morphology of seeds is variable and different among the species of *Pseudostellaria* in Korea (Choi, 1999). The seed surfaces of *P. palibiniana*, *P. okamotoi*, and *P. heterophylla* show roundly conical papillae distributed evenly, with the anticlinal cell walls branching radially and irregularly and tightly interweaving with adjacent cells. Slender spinules are seen at the top of papillae. In contrast, the branches of anticlinal cell walls are few and rough in *P. heterophylla* (Choi, 1999: 25, fig. 5), many and delicate in *P. palibiniana* (Choi, 1999: 26, fig. 9), or intermediate in *P. okamotoi* (Choi, 1999: 26, fig. 7). In particular, *P. longipedicellata* and *P. palibiniana* are quite distinct in several features of surface morphology (cf. Fig. 3). Branching of anticlinal cell walls of *P. longipedicellata* appear short and wide, but are long and narrow in *P. palibiniana*; spinules of the former are short, but elongate in the latter; ultra-reticular calcium carbonate debris on the papilla of the former is scarce or absent, but evenly distributed in the latter. The seed surface morphology of *P. longipedicellata* is quite distinctive from that of *P. palibiniana*, and more closely resembles that of *P. okamotoi* (Choi, 1999: 26, fig. 7).

Cleistogamy is common within *Pseudostellaria* (Ohwi, 1937), and the cleistogamous capsules are borne at the axil of leaves typically at the proximal part of the stem. Based on the authors' observations, cleistogamous capsules appear to be rare in *P. longipedicellata*, in contrast to *P. palibiniana* and *P. heterophylla*. This may suggest that *P. longipedicellata* is a facultative autogamous species, with this observation supported by the fact that in this species, seed sets approach 100% (S. T. Lee, unpublished).

The color of fruits and pedicels is reddish brown. This color and the ground-level fruit might suggest that the fruits attract ants and that the seeds are dispersed by ants (Fig. 2D). Many wandering ants were observed under the clustered plants of *Pseudostellaria longipedicellata*, although ant dispersal of seeds was not directly observed. Among other taxa, ant-pollinated flowers bloom near the ground and/or exhibit similar reddish brown perianths (Proctor & Yeo, 1973; Beattie, 1985). This has been noted in *Asarum* L. (Aristolochiaceae; Smith et al., 1989), *Leavenworthia* Torr. (Brassicaceae; Wyatt, 1981), *Lepidium* L. (Brassicaceae; Gomes et al., 1986), *Balanophora* J. R. Forst. & G. Forst. (Balanophoraceae; Kawakita & Kato, 2002), *Microtis* R. Br. (Orchidaceae; Peakall & Beattie, 1991), as well as other Caryophyllaceae, including *Arenaria* L. and *Gypsophila* L. (Gomes et al., 1986). Ants may disperse small seeds of many annual herbs (Lach, 2003), including *Stellaria* L., which is affined to *Pseudostellaria* (Kjellsson, 1985). The clustered habit of plants of *P. longipedicellata* may be caused not only by short rhizomes but also by the ants that collect the seeds for food reserve (Beattie, 1985; Lach, 2003). We did observe moist capsules that were partially foraged by insects (Fig. 2F), although in none of them did the dried capsule dehisce naturally. We did not observe any insect taxa other than ants in association with the fruits. Further studies are required to confirm the pollination and seed dispersal mechanisms in *P. longipedicellata*.

Paratypes. (Asterisks indicate collections measured for Table 1). KOREA. **Chungcheongbuk:** Chungju, Seokmun-dong, 16 May 2006, **G. H. Nam NGH60317* (KH);

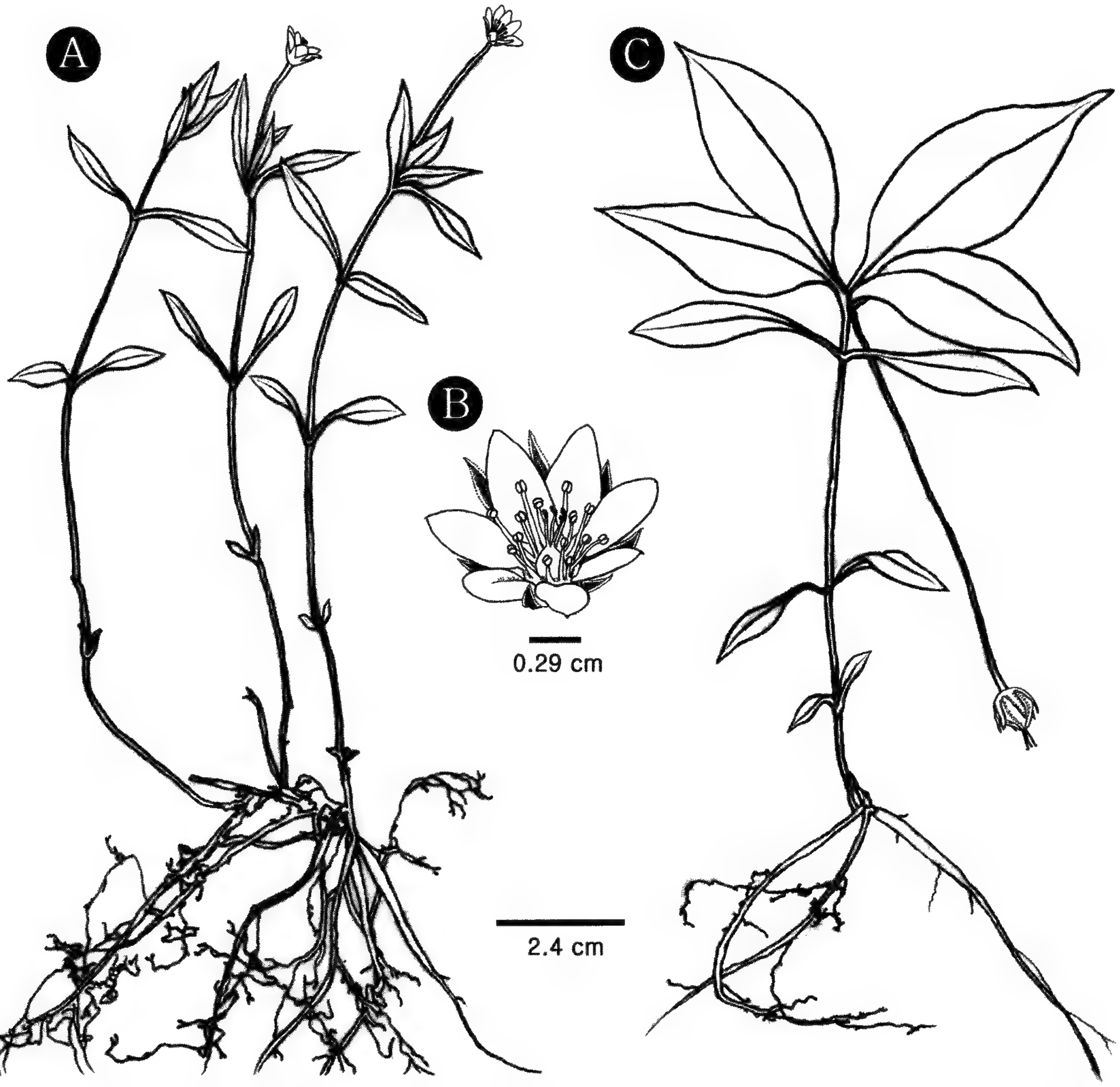

Figure 1. *Pseudostellaria longipedicellata* S. Lee, K. Heo & S. C. Kim. —A. Habit of flowering plant. —B. Flower. —C. Habit of fruiting plant, showing the post-anthesal elongation of the pedicel. A, B drawn from *Heo et al. HKI060010* (SKK); C drawn from *Heo HKI050010* (SKK).

Jecheon, Seongnaeri, 15 May 2006, **G. H. Nam & H. S. Choi NGH60170* (KH); Mt. Joryeong, 17 May 2006, **S. H. Park & H. S. Choi Park SH63491* (KH); Mt. Weorak, 4 May 2002, **S. T. Lee et al. 26376* (SKK), 4 May 2002, **S. T. Lee et al. 26377* (SKK), 4 May 2002, *S. H. Park SH21161* (KH), 4 May 2002, **S. H. Park SH21149* (KH), 4 May 2002, *S. H. Park SH21165* (KH), 4 May 2002, *S. H. Park SH21150* (KH), 4 May 2002, *S. H. Park SH21164* (KH). **Daegu Metropolitan City:** Mt. Biseul, 18 May 1997, **J. H. Park 4026* (KNU). **Gangwon:** Mt. Daedeok, 18 June 2005, **K. I. Heo & J. E. Go s.n.* (SKK); Mt. Deokhang, 23 May 2004, **J. S. Kim kjs050066* (KH); Mt. Myeon, 30 Apr. 2006, **K. I. Heo et al. HKI060010* (SKK); Mt. Taebaek, 1 June 1996, *S. T. Lee et al. s.n.* (SKK), 7 May 1999, **C. J. Lee s.n.* (SKK), 24 May 2002, **S. T. Lee et al. s.n.* (SKK), 2 May 2004, **K. I. Heo et al. s.n.* (SKK), 2 May 2004, *H. M. Hwang et al. s.n.* (SKK), 2 May 2004, *M. H. Im et al. s.n.* (SKK), 15 May 2005, *S. T. Lee et al. s.n.* (SKK), 15 May 2005, *M. H. Im et al. s.n.* (SKK), 15 May 2005, *N. I. Gong et al. s.n.* (SKK), 15 May 2005, *S. R. Lee et al. s.n.* (SKK), 15 May 2005, *Y. D. Kim et al. s.n.* (SKK), 15 May 2005, *T. E. Park et al. s.n.* (SKK), 4 June 2005, **K. I. Heo et al. HKI05510* (SKK). **Gyeongsangbuk:** Mt. Naeyeon, 13 Apr. 1992, **K. Choi 26* (KNU), **K. Choi 27* (KNU).

KEY TO *PSEUDOSTELLARIA* SPECIES IN KOREA MORPHOLOGICALLY SIMILAR TO *P. LONGIPEDICELLATA* (ADAPTED FROM CHOI [1993, 1999] AND LEE [1997])

1a. Distal leaves subverticillate; flowers terminal (*Pseudostellaria* subser. *Verticillate* Ohwi) 2
  2a. Taproots several, fascicled; pedicels glabrous; flowers solitary and terminal 3
    3a. Stems basally erect and robust, 7.3–19.5 cm; distal subwhorled leaves narrowly ovate or elliptic and becoming ovate; pedicel elongating 1.8–3.7 cm, but not to the ground ..... *P. palibiniana*

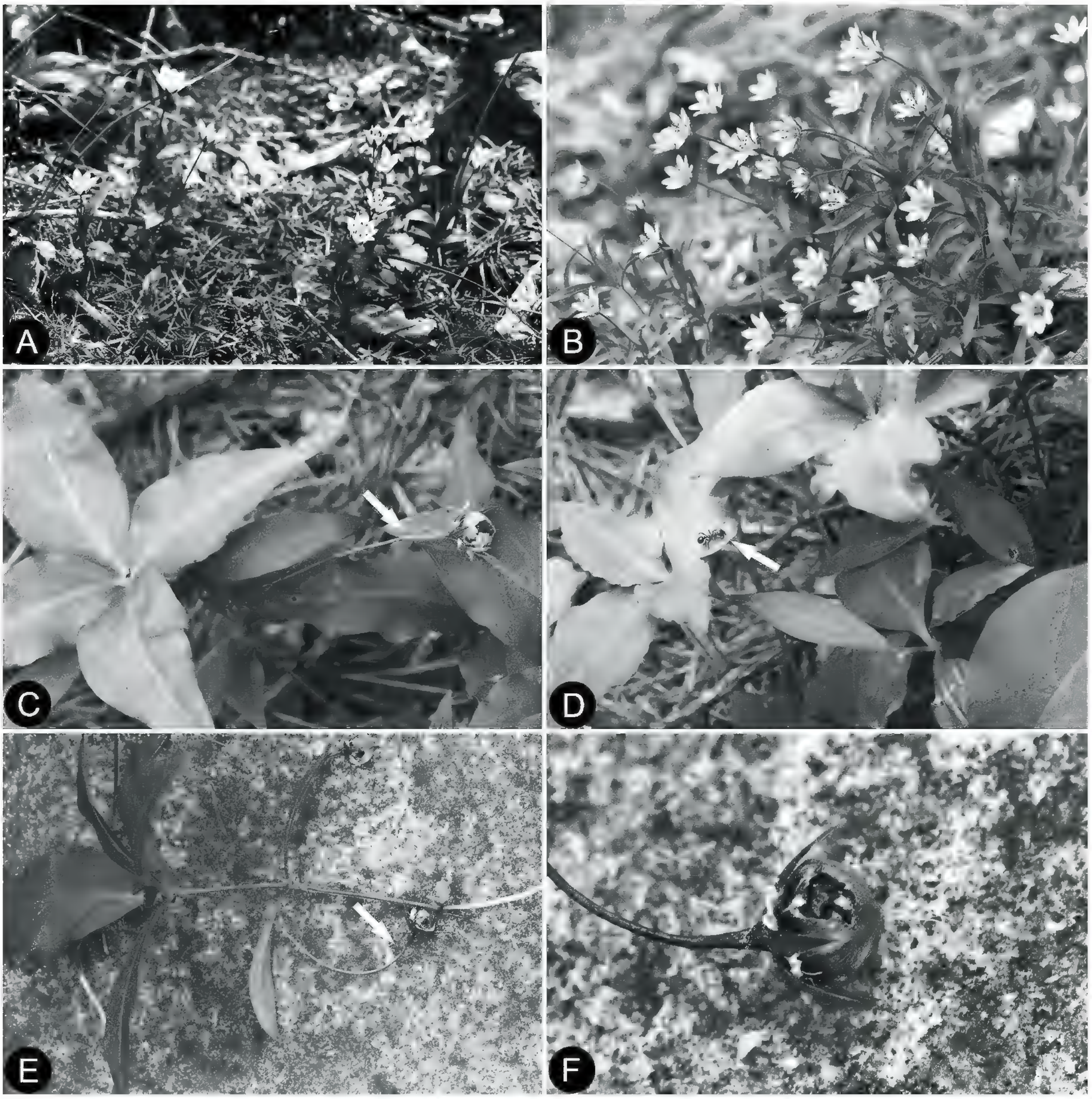

Figure 2. *Pseudostellaria longipedicellata* S. Lee, K. Heo & S. C. Kim during the anthesal period in 2007 at the type locality in Gangwon Province, Korea. —A. Flowering, which started by April 27. —B. Clustered plants in full bloom on April 30. —C. Elongated pedicels (indicated by one arrow) of early flowers on May 4. —D. Ant on leaf. —E. Post-anthesal pedicels complete in their elongation and dropping (at arrow) on June 4. —F. Close-up of a fruit foraged by insects on June 4. Photographs taken by K. I. Heo and Samjo Chung.

3b. Stems basally decumbent and slender, 6–14 cm; distal subwhorled leaves oblanceolate or lanceolate and becoming elliptic or narrowly ovate; pedicel extends down 3.8–6.9 cm until reaching the ground ..... *P. longipedicellata*

2b. Taproots 0 to 2; pedicels pubescent; flowers 1 to 5 per stem and terminal 4

4a. Pedicels vertically pubescent along one side; flowers solitary per stem; petals acute ..... *P. okamotoi*

4b. Pedicels entirely pubescent; flowers 1 to 5 per stem and terminal; petals emarginated 5

5a. Roots fusiform, not long-rhizomatous; leaves basally pubescent; flowers 1 to 8 per stem, petals 5 ..... *P. heterophylla*

5b. Roots fibrous, long-rhizomatous; leaves pubescent along the midrib and margin; flowers solitary per stem, petals 6 ..... *P. setulosa*

1b. Distal leaves opposite; flowers terminal or lateral (*Pseudostellaria* subser. *Distantes* Ohwi) 6

6a. Stems erect, not creeping; distal leaves linear to lanceolate ..... *P. sylvatica* (Maxim.) Pax

6b. Stems erect, creeping after anthesis; distal leaves obovate ..... *P. davidii* (Franch.) Pax

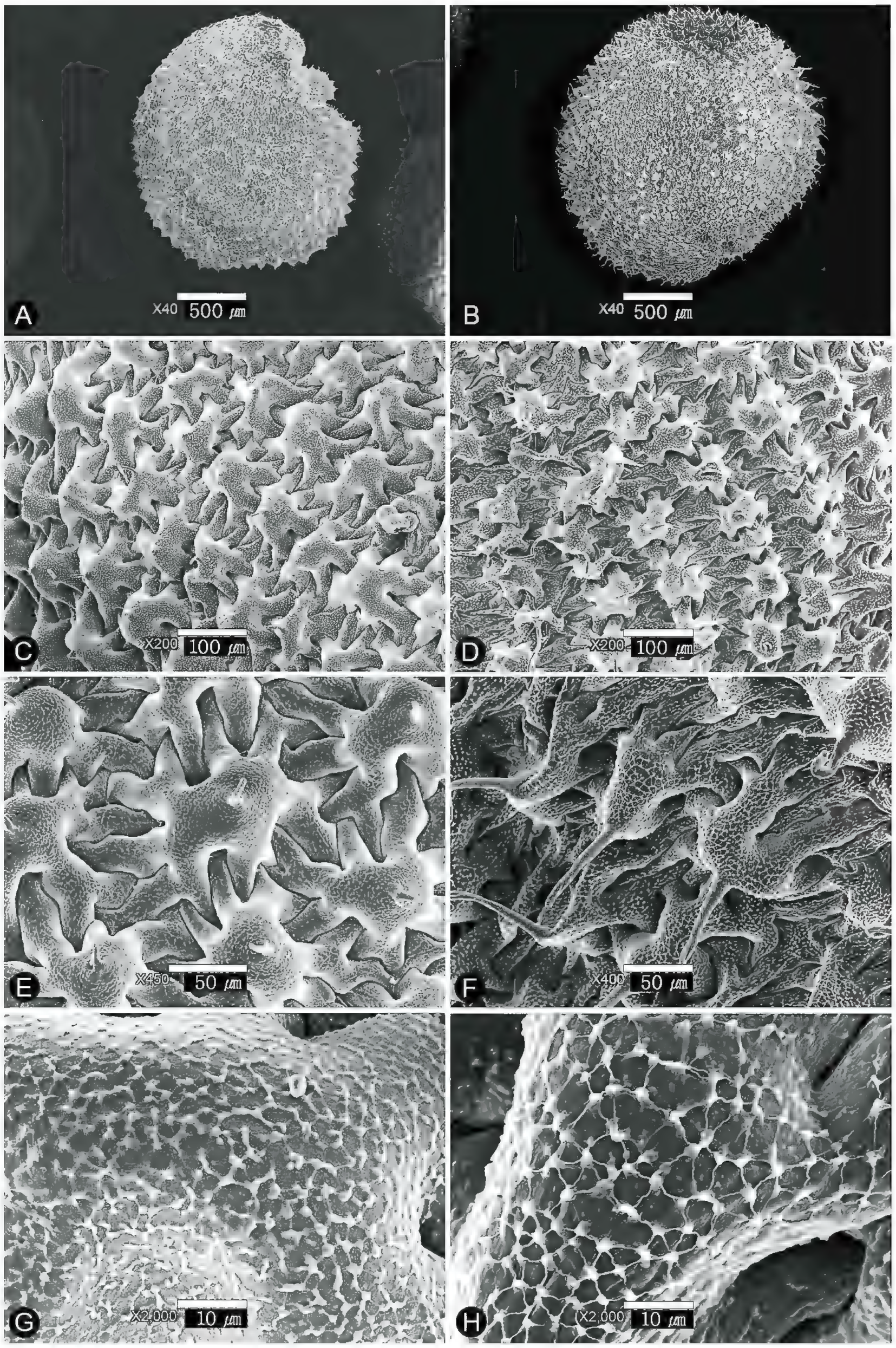

Figure 3. SEM micrographs of seeds of *Pseudostellaria longipedicellata* S. Lee, K. Heo & S. C. Kim (A, C, E, G) and *P. palibiniana* (Takeda) Ohwi (B, D, F, H). —A, B. Fruit shapes. —C–H. Fruit surfaces. Photos A, C, E, and G were taken from *Heo HKI050010* (SKK); photos B, D, F, and H were taken from *S. T. Lee & K. Heo S.Lee050010* (SKK).

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Identifications and Typifications of *Rosa* (Rosaceae) Taxa in North America Described or Used by E. W. Erlanson, 1925–1934

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ABSTRACT. During her main publication period at the University of Michigan from 1926 to 1937, E. W. Erlanson described 18 new *Rosa* L. species and varieties (Rosaceae), most from the midwestern United States. The majority were grown and hybridized at the University of Michigan Botanical Garden, where she collected many specimens for the University of Michigan Herbarium (MICH) over a period of years. Some living collections were hers, but most were from others who sent living plants usually without voucher specimens. For this reason and the inability until recently to use sheets as types from living collections under specific circumstances, type selections were at times inappropriate. Nevertheless, seven (almost half) of the cited holotypes here are in MICH, in addition to three lectotypes designated here, as well as isotypes and isolectotypes. A total of 40 taxa with either type data or in synonymy are identified in 10 categories of *Rosa* species, subspecies, and nothospecies following the *Flora of North America* treatment. Lectotypes are designated here for the following 19 names: *R. acicularioides* Schuette, *R. acicularis* Lindl. var. *bourgeauiana* Crép., *R. arkansana* Porter, *R. blanda* Aiton fo. *carpohispida* Schuette, *R. blanda* var. *glandulosa* Schuette, *R. blanda* var. *hermannii* Erlanson, *R. blanda* var. *nuda* Schuette, *R. blanda* var. *subgeminata* Schuette, *R. californica* Cham. & Schltdl., *R. carolina* L. var. *aculeata* (Schuette) Erlanson, *R. carolina* var. *litoralis* Erlanson, *R. deamii* Erlanson, *R. gemella* Willd., *R. nitida* Willd., *R. carolina* var. *inermis* Schuette, *R. carolina* var. *sepalorelevata* Schuette, *R. pensylvanica* Michx., *R.* ×*rudiuscula* (Greene) Erlanson, and *R. suffulta* Greene var. *valida* Erlanson. One neotype is designated, *R. palustris*. In addition, holotypes of the following taxa are identified for the first time: *R. blanda* var. *setigera* Crép., *R. blanda* var. *hispida* Farw., and *R. blanda* fo. *alba* (Schuette ex Erlanson) Fernald.

Key words: E. W. Erlanson, North America, *Rosa*, Rosaceae, University of Michigan.

In her early research on *Rosa* L. (Rosaceae) at the University of Michigan, Eileen W. Erlanson described 18 new taxa, six species, and 12 varieties in two publications (Erlanson, 1926, 1928). Most are native to the Midwest, but a few occur in California, the Rocky Mountains, and New York State. One additional variety in California was recognized in a later publication (Erlanson, 1934). However, by the publication of this final and seminal research paper, which provided experimental data for a revision of North American roses, the majority of taxa Erlanson had previously described were synonymized or excluded from consideration. It seems that Erlanson had initially followed E. L. Greene and P. A. Rydberg by describing new taxa routinely when variant characters were found, but she later dropped their approach when her research showed that inherent variations in the form of unreliable variation were common in *Rosa* species, a finding further confounded by both polyploidy and hybridization.

Although Erlanson did not plan to produce a monographic treatment of North American roses, typifications were often difficult to provide since herbarium vouchers of wild collections were rarely made by those sending her live material. In a 1 July 1925 letter to C. C. Deam at Indiana University, Erlanson wrote, when discussing collected living material, "I wish I had herbarium specimens of all of them taken before they were sent here," suggesting that many living collections destined for the University of Michigan Botanical Garden were not accompanied by original herbarium collections. In the absence of these potential types, we have used sheets taken from living material to designate lectotypes, thanks to the assistance of Kanchi Gandhi (GH), who reminded us that we could consider certain sheets from living

collections as uncited original material when solid evidence existed for their use in descriptions of new taxa. Under this condition, such sheets could become eligible for selection as lectotypes (Art. 9.10, *International Code of Botanical Nomenclature* [McNeill et al., 2006]). We designate a total of 19 lectotypes and one neotype here, and we provide holotypes and isotypes of taxa with cited herbaria as well. A total of 40 taxa, either provided with typification data or treated as synonyms, are also placed in currently accepted names, following the treatment of *Rosa* in the *Flora of North America* (Lewis et al., 2012). For the majority of species and varieties, we provide a brief statement, when appropriate, regarding the status of each taxon at the conclusion of Erlanson's (1934) research, largely taken from her appendices 2 and 3, consisting of an alphabetical list of taxa and an analytical key, respectively. We briefly discuss new tetraploid populations of *Rosa* discovered by Erlanson (1931) in Oregon based on seven herbarium collections recently made available by the University of Michigan Herbarium (MICH). The biographical notes by Lewis in Appendix 1 are his reflections on Dr. Erlanson, which are based largely on the time when, as a graduate student studying *Rosa*, he received valuable assistance from the then-leading research roseologist in the country.

Taxonomic Treatment

1. Rosa acicularis Lindl. subsp. **sayi** (Schwein.) W. H. Lewis, Brittonia 11(1): 19. 1959. Basionym: *Rosa sayi* Schwein., in W. H. Keating, Narr. Exp. St. Peter's River 2: 388. 1824. *Rosa acicularis* var. *sayi* (Schwein.) Rehder in L. H. Bailey, Cycl. Amer. Hort. 4: 1555, pl. 2161. 1902. *Rosa acicularis* var. *sayiana* Erlanson, Pap. Michigan Acad. Sci. 5: 85. 1926, nom. illeg. TYPE: U.S.A. Minnesota: Falls of St. Anthony (now St. Anthony Park in north Minneapolis), *L. D. von Schweinitz s.n.* (holotype, PH).

Rosa acicularis var. *bourgeauiana* Crép., Bull. Soc. Roy. Bot. Belgique 15(1): 29. 1876. Basionym: *Rosa bourgeauiana* Crép., Bull. Soc. Roy. Bot. Belgique 15: 29. 1876, pro syn. TYPE: Canada. Alberta/ Saskatchewan: basin of Saskatchewan [River], in woods, 12 July 1858, fol. 1, *E. Bourgeau s.n.* [Palliser's British N. Am. Expl. Expedition 1857–1858] (lectotype, designated here, P-511864; isolectotypes, BR, CGE).

Rosa acicularis var. *lacuum* Erlanson, Pap. Michigan Acad. Sci. 5: 86. 1926, as "*lacorum*," syn. nov. TYPE: U.S.A. Michigan. Mackinac Co., Scotty Bay, 1924, *C. O. Erlanson & E. W. H. Erlanson 761* (holotype, MICH-1111295).

Rosa acicularis var. *rotunda* Erlanson, Pap. Michigan Acad. Sci. 5: 84. 1926, syn. nov. TYPE: U.S.A. Michigan: Cheboygan Co., North Fishtail Bay, Douglas Lake, 1924, *C. O. Erlanson & E. W. Erlanson 628* (holotype, MICH-1111296).

Rosa blanda Aiton var. *setigera* Crep., Bull. Soc. Roy. Bot. Belgique 15: 37. 1876, syn. nov. TYPE: U.S.A. Colorado, Fremont Co., near Canon City, 1874, *T. S. Brandegee s.n.* (holotype, K).

In his protologue of *Rosa acicularis* var. *bourgeauiana*, Crépin added that the type was collected between Ft. Carlton (north of Saskatoon, Saskatchewan) and Ft. Edmonton (Edmonton, Alberta). A second sheet (P-511865-6) includes two further collections, fol. 2, 14 July 1858, and fol. 3, 21 Sep. 1858, at Edmonton. All three collections are labeled *R. bourgeauiana* Crép. with brief descriptions in his writing. Crépin further noted that he had already used the binomial for similar material at B, now destroyed. All are typical of *R. acicularis* subsp. *sayi* (Schwein.) W. H. Lewis. Erlanson (1934: 250) included *R. bourgeauiana* in synonymy of *R. acicularis*.

In her last taxonomic paper in which *Rosa acicularis* was considered (Erlanson, 1934), Erlanson did not include *R. acicularis* var. *lacuum* and *R. acicularis* var. *rotunda* in text, as synonyms, or in keys (appendices 2 and 3); presumably they were considered of little consequence by their author.

Erlanson proposed *Rosa acicularis* var. *sayiana* as a substitute name for *R. acicularis* var. *sayi*. Erlanson (1926: 85) considered the latter an invalid name since Rehder failed to cite a basionym in 1902. However, basionyms were not required for such publications until 1 Jan. 1953, when they were mandated by the *International Code of Botanical Nomenclature* (McNeill et al., 2006). *Rosa acicularis* var. *sayiana* is therefore illegitimate per Article 52.1 of the Code (McNeill et al., 2006). In 1934 (p. 255), Erlanson recognized only *R. acicularis*, but both *R. acicularis* subsp. *acicularis* (mostly Eurasian) and *R. acicularis* subsp. *sayi* (mostly North American) are separately recognized in the *Flora of North America* (Lewis et al., 2012).

Crépin cited only the *T. S. Brandegee* collection of 1874 when describing *Rosa blanda* var. *setigera*. In his discussion of the variety (Crépin 1876: 36–37), he noted that it was similar to *R. acicularis* var. *bourgeauiana*.

2. Rosa arkansana Porter, in Porter & Coulter, Syn. Fl. Colorado 38. 1874 [in Hayden's U.S. Geol. & Geogr. Surv. Territory 1873, Misc. Pub. 4, Syn. Fl. Colo. 1874]. *Rosa blanda* var. *arkansana* (Porter) Cockerell, W. Amer. Sci. 5: 11. 1888, syn. nov. *Rosa blanda* var. *arkansana* (Porter) Best, Bull. Torrey Bot. Club 17: 145. 1890, nom. illeg. *Rosa virginiana* Mill. var. *arkansana*

(Porter) Macmill., Metasp. Minnesota Valley 304. 1892. TYPE: U.S.A. Colorado: Fremont Co., banks of Arkansas [River] near Canon City, 19 July 1873, *T. S. Brandegee 664* (lectotype, designated here, MO-1969827; isolectotypes, GH-32555, K, NA, NY-415911 [fragm.], NY-743774 [fragm.], UC).

Rosa alcea Greene, Leafl. Bot. Observ. Crit. 2(3): 63. 1910. TYPE: Canada. Saskatchewan [as "Assiniboia"]: Moose Jaw, June 1892, *W. Spreadborough s.n.* [J. M. Macoun, Geological Survey of Canada (GSC-10624)] (holotype, CAN-74865; isotype, CAN-74866).

Rosa ratonensis Erlanson, Rhodora 30: 115. 1928. TYPE: U.S.A. New Mexico: Colfax Co., top of Raton Pass, in sandy clay, 17 June 1925, *C. O. Erlanson 1062* (holotype, MICH-1002589).

Rosa suffulta Greene var. *valida* Erlanson, Rhodora 30: 114. 1928, syn. nov. TYPE: U.S.A. New York: Essex Co., near Minerva, 5 Aug. 1927, *H. D. House 15169* (lectotype, designated here, NYS; isolectotype, MICH-1210439).

At the base of the lectotypic sheet of *Rosa arkansana*, written in faded pencil, likely by G. Engelmann, is "J. W. Porter last letter makes [Brandegee] 664 *R. arkansana* nov. sp." For this reason, and since descriptions of the type and protologue are similar, this specimen was selected as the lectotype. *Rosa blanda* var. *arkansana* by G. N. Best, 1890, is a later homonym of the same trinomial provided by T. D. A. Cockerell, 1888, and is therefore illegitimate. No specimens from Custer Co. (ca. 8400 ft.) were cited either by Cockerell, in his very brief protologue, or by G. N. Best, who described the variety at length, a description that is clearly *R. arkansana* as understood today. Erlanson recognized the species in 1934, as do Lewis et al. in the *Flora of North America* treatment (2012).

Erlanson (1934: 250) considered *Rosa alcea* an "ecotype species" of *R. arkansana* with *R. lunellii* Greene and *R. subglauca* Rydb. in synonymy. In her final key (1934: 255), Erlanson recognized *R. alcea* as a species of the northern Great Plains. The species is currently considered a synonym of *R. arkansana*.

Erlanson (1934: 250) included *Rosa ratonensis* as a synonym of *R. arkansana*.

The first cited paratype of *Rosa suffulta* var. *valida* is selected as type since a sheet is available at MICH where Erlanson conducted her research. Further, its characters are within the protologue's description. The other paratype from the same locality was collected on 9 Aug. 1927, *H. D. House 15247* (NYS). Both collections were undoubtedly introduced plants to New York from more western localities and possibly were short-lived. The type that Erlanson (1928) cited from Missouri (Atchison Co., Rockport, 1 Nov. 1923, *A. Hamilton & P. Hamilton s.n.*) is not at MICH, and original material was likely never collected. The existence of the House collection precludes the need to consider a specimen collected from the living collections that Erlanson cited (*University of Michigan Botanical Garden 4459*) as a lectotype. Erlanson (1934: 250) included *R. suffulta* as a synonym of *R. arkansana*. When Erlanson described the varietal epithet *valida* in 1928, the trinomial was validly published as Erlanson did not purport that *R. suffulta* contained the type of the name (ICBN, Art. 24.3 [McNeill et al., 2007]).

3a. Rosa blanda "(b)" Aiton, Hortus Kew. (W. Aiton) 2: 202. 1789. TYPE: Canada. Hudson's Bay: cultivated. 1773. *James Gordon* (lectotype, designated by Fernald [1918: 92], BM).

Rosa acicularioides Schuette, Proc. Amer. Assoc. Advancem. Sci. 46: 279. 1898. TYPE: U.S.A. Wisconsin: Door Co., Lily Bay, 18 Aug. 1891, *J. H. Schuette s.n.* (lectotype, designated here, GH; isolectotypes, F, K, US-380319).

Rosa blanda var. *glandulosa* Schuette, Proc. Amer. Assoc. Advancem. Sci. 46: 279, 1898, syn. nov. TYPE: U.S.A. Wisconsin: Door Co., Little Sturgeon Bay, 18 July 1892, *J. H. Schuette s.n.* (lectotype, designated here, K; isolectotype, BM).

Rosa blanda var. *hermannii* Erlanson, Rhodora 30: 113, 1928, syn. nov. TYPE: U.S.A. Michigan: Houghton Co., 7 mi. from Laurium, dry sand shore of Bear Lake, *Univ. Michigan Bot. Gard. 2686*, 5 Aug. 1925 (lectotype, designated here, MICH-1210438; isolectotype, MO-1220140).

Rosa blanda var. *hispida* Farw., Pap. Michigan Acad. Sci. 2: 25. 1923, syn. nov. TYPE: U.S.A. Michigan: Wayne Co., Belle Isle, Detroit metro area, 4 June 1895, *O. A. Farwell 971 1/2* (holotype, MICH-1111297).

Fernald (1918) selected a collection of Schuette in GH as type material of *Rosa acicularioides*. Having seen the type material at F, Erlanson (1926: 85) stated that the species was a form of *R. blanda*. By 1934 (250), Erlanson had reduced it to synonymy of *R. blanda*.

The brief description of *Rosa blanda* var. *glandulosa* by Schuette agrees with that of the lectotype. By 1934 (216), Erlanson considered this variety, *R. blanda* var. *hispida*, *R. acicularioides*, and *R. palustriformis* Rydb. as all having insignificant minor variable characters. *Rosa blanda* var. *glandulosa* was not included in the 1934 paper's summary appendices 2 and 3.

The type cited by Erlanson (1928: 113) of *Rosa blanda* var. *hermannii* Erlanson (*F. J. Hermann s.n.*, Oct. 1922) is not in MICH and appears to be lost (or perhaps it was only a seed source). However, seven sheets with the University of Michigan Botanical Garden number 2686 represent cultivated material from the approximate type locale, collected from June to August in 1925. Since the Hermann collection was from October and the varietal description includes

floral information only available from flowering material in June or rarely to July, the cultivated material was used to describe the variety and constitutes uncited original material (Art. 9.10 [McNeill et al., 2006]). Material of the second collection cited by Erlanson (1928) (*W. Brotherton Jr. s.n.*, Oct. 1922) is also missing, but its living material (collected under the University of Michigan Botanical Garden number 2668) has no priority over the first cited material. Erlanson did not include taxonomic consideration of the variety in 1934.

Rosa blanda var. *hispida* was recognized by Erlanson (1934: 255), but except for fine prickles or aciculi on some branches, it is very similar to *R. blanda*. Progeny from a single wild collection of *R. blanda* included *R. blanda* var. *hispida* as well as *R. blanda* var. *glandulosa* and *R. blanda* var. *acicularioides*, both cited above, while the majority of progeny were typical of the species (Erlanson, 1934: 236–237). See the *R. blanda* var. *glandulosa* discussion above. Surprisingly, Erlanson included the variety in her final key (1934, app. 3: 255).

3b. Rosa blanda Aiton fo. **alba** (Schuette ex Erlanson) Fernald, Rhodora 50: 146. 1948. Basionym: *Rosa blanda* var. *alba* Schuette ex Erlanson, Pap. Michigan Acad. Sci. 5: 88. 1926. TYPE: U.S.A. Wisconsin: Brown Co., Albany, near Stado farm, 16 June 1895, *J. H. Schuette s.n.* (holotype, F-379239).

3c. Rosa blanda Aiton fo. **carpohispida** (Schuette) W. H. Lewis, Rhodora 60: 240. 1958. Basionym: *Rosa blanda* var. *carpohispida* Schuette, Proc. Amer. Assoc. Advancem. Sci. 46: 279. 1898. TYPE: U.S.A. Wisconsin: Door Co., Little Sturgeon Bay, 17 Aug. 1891, *J. H. Schuette s.n.* (lectotype, designated here, US-752278).

The collection selected as lectotype was cited in the exsiccatae of *Rosa blanda* fo. *carpohispida*, which illustrates its atypical stipitate-glandular hypanthia and pedicels also noted in the original description by Schuette. Erlanson recognized predominantly *R. blanda* var. *carpohispida* in a study of offspring of *R. blanda* from Quebec (1934: 237, tab. B), but *R. blanda* var. *carpohispida* was excluded from the final appendices 2 and 3.

4. Rosa bridgesii Crép. ex Rydb., Bull. Torrey Bot. Club 44(2): 83. 1917, nom. cons. (Ertter, 2007). TYPE: U.S.A. California: 1857, *Bridges 62* (holotype, K).

Rosa bridgesii includes *R. calvaria* Greene, which Erlanson (1934: 230, key 258) considered closely related to *R. gymnocarpa* Nutt. and which was retained as an ecotype species of *R. gymnocarpa* (1934: 251). In addition, *R. covillei* Greene became a synonym of *R. gymnocarpa* (1934: 251). Erlanson (1934: 230, key 257) recognized *R. yainacensis* Greene (with synonyms *R. myriadenia* Greene and *R. pinetorum* A. Heller) as an ecotype species of *R. durandii* Crép. *Rosa bridgesii* nom. cons. is conserved against five other names (Ertter, 2007). The species is included in the *Flora of North America* treatment for *Rosa* (Lewis et al., 2012).

5. Rosa californica Cham. & Schltd., in D. F. L. von Schlechtendal, Linnaea 2: 35. 1827. TYPE: U.S.A. California: San Francisco, *Chamisso & Eschschultz s.n.* [Chamisso Herbarium, annotated by Crépin] (lectotype, designated here by B. Ertter, LE).

The lectotype label selected by B. Ertter in St. Petersburg includes San Francisco, "Nob." and "Herb. Cham.," making this the obvious candidate. The species was probably collected during the Kotzebue expedition by the ship *Rurik* at the Presidio, October 1816 (Eastwood, 1944).

Rosa californica Cham. & Schltd. var. *bidenticulata* (Rydb.) Erlanson, Bot. Gaz. 96: 222. 1934. Basionym: *Rosa bidenticulata* Rydb., N. Amer. Fl. 22(6): 518. 1918. TYPE: U.S.A. California: Shasta Co., Castella, 24 July 1912, *A. Eastwood 1389* (holotype, A-32560; isotype, CAS).

In his revision of the *Rosa californica* complex, Cole (1956) included *R. californica* var. *bidenticulata* as a synonym of *R. pinetorum* without further discussion. However, B. Ertter (pers. comm., 2010) noted that *R. californica* var. *bidenticulata* "is part of the unresolved variation in *R. californica*, possibly resulting from occasional hybridization with *R. bridgesii* Crép. ex Rydb." Clearly, the identification of this variety as *R. pinetorum* is very much in question and for now is retained within *R. californica* s.l. Erlanson (1934: app. 3, 257) recognized the variety in her final key.

6. Rosa carolina L., Sp. Pl. 492, 1753, non *Rosa carolina* L., 1762. TYPE: U.S.A. Carolina (holotype), designated by Heath (1992: 51, 80), confirmed by Jarvis (2007), J. Dillenius, Hort. Eltham. 2: 325, pl. 245, fig. 316. 1732: "pl. Rosa Carolina fragrans, folis mediotenus serratis." Figures 1, 2.

To our knowledge these are the first original figures of the *Rosa carolina* holotype provided in a North American journal. This is significant since only three

Figure 1. Plate 245 by J. J. Dillenius illustrating figures of *Rosa carolina* and *R. sanguisorbaefolia*. Taken from Johann Jacob Dillenius, *Hortus Elthamensis*, 2: 325, London, 1732. This figure was scanned from the copy of *Hortus Elthamensis* at the Missouri Botanical Garden Library.

known copies of the 1732 *Hortus Elthamensis* are cited (MO, NY, U) by Stafleu and Cowan (1976: 656).

6a. **Rosa carolina** subsp. **carolina** L.

Rosa carolina var. *sabulosa* Erlanson, Rhodora 30: 118. 1928. TYPE: U.S.A. Indiana: Lake Co., Gary, Pine St. [now Clark], 11 Aug. 1923 [label, 7 Aug.], *C. C. Deam 39461* (holotype, IND-21978).

Rosa deamii Erlanson, Rhodora 30: 120. 1928. *Rosa carolina* var. *deamii* (Erlanson) Deam, Fl. Indiana 576. 1940. TYPE: U.S.A. Indiana: Tipton Co., 1.5 mi. W of Goldsmith [nearby Kempton on label], along the Nickel [as Nickle] Plate Railway, 17 [in sched.], Sep. 1923, *C. C. Deam 39818* (lectotype, designated here, IND; isolectotype, IND, MICH-1210436, MO-5472586).

In her writing and signed "EWE" on the IND type annotation sheet in 1925, Erlanson considered *Rosa carolina* var. *sabulosa* a "glabrous, non-glandular form of *R. carolina* L." No further discussion of the variety is found, including in her revision of North American wild roses (Erlanson, 1934).

The lectotype is similar to the descriptive protologue of *Rosa deamii* Erlanson. However, the Goldsmith locality provided in the protologue differs from the label where the larger town Kempton is given. Both towns are in the same general location. Erlanson (1934: 250) correctly included *R. deamii* as a synonym of *R. carolina*.

Figure 2. Detail: figure 316, *Rosa carolina*, from plate 245 by J. J. Dillenius, enlarged ca. 1/2. Imaging only and edited version of the holotype of *R. carolina* L. Taken from Johann Jacob Dillenius, *Hortus Elthamensis*, 2: 325, London, 1732. This figure was scanned from the copy of *Hortus Elthamensis* at the Missouri Botanical Garden Library.

6b. **Rosa carolina** subsp. **subserrulata** (Rydb.) W. H. Lewis, Novon 18(2): 195. 2008. Basionym: *Rosa subserrulata* Rydb., N. Amer. Fl. 22: 500. 1918. TYPE: U.S.A. Missouri: Taney Co., Swan [Township], 2 June 1899, *B. F. Bush 42* (holotype, NY-429910; isotype, MO-5255457).

Rosa carolina var. *litoralis* Erlanson, Rhodora 30: 119, 1928, syn. nov. TYPE: U.S.A. Illinois: Cook Co.,

Evanston, campus of Northwestern University, 4 Oct. 1927, *s. coll.*, *Univ. Michigan Bot. Gard. 2654* (lectotype, designated here, MICH-1210437).

Rosa housei Erlanson, Rhodora 30: 117. 1928. TYPE: U.S.A. New York: Warren Co., shore of Moxham Pond near North Creek, 13 July 1927, *H. D. House 14900* (holotype, NYS; isotype, MICH-1111298).

Rosa relicta Erlanson, Rhodora 30: 116. 1928, syn. nov. *Rosa suffulta* var. *relicta* (Erlanson) Deam, Fl. Indiana 577. 1940. TYPE: U.S.A. Illinois: Kane Co., Bliss Woods, residual prairie, 30 July 1925, *C. O. Erlanson & E. W. Erlanson 1533* (holotype, MICH-1210130; isotypes, MO, NY).

Rosa ×*rudiuscula* (Greene) Erlanson, pro sp., emend. Bot. Gaz. 96: 253, 1934 [*Rosa arkansana* Porter × *Rosa carolina* L.]. *Rosa rudiuscula* Greene, Leafl. Bot. Observ. Crit. 2: 134. 1911. TYPE: U.S.A. Missouri: Jackson Co., Little Blue, rocky woods, 22 July 1896, *B. F. Bush 208* (lectotype, designated here, NDG-23617; isolectotypes, BR, MO-525543, NY-415879 [fragm.].

The original collection of *Rosa carolina* var. *litoralis* by *A. W. H. Povah s.n.*, 3 Oct. 1922, is presumably lost, if indeed it was ever collected. Other original material is based on five living collections obtained over the years between June and October and collected under University of Michigan Botanical Garden number 2654. Since the Povah collection was made in October, when only fruits would be found, detailed floral data could only have been available for the varietal description from collections numbered 2654 that flowered in June (most do; pers. obs.). These are therefore uncited original material, and we selected one as lectotype. The lectotype is similar to typical forms of *R. carolina* subsp. *subserrulata*. Erlanson did not recognize *R. carolina* var. *litoralis* in 1934.

Erlanson (1934: 230) considered *Rosa housei* an eastern swamp-inhabiting ecotype or ecophene of *R. arkansana* and, later, in the same paper (1934: 250) an ecotype species of *R. arkansana*. However, *R. housei* is representative of the infrequently found *R. carolina* subsp. *subserrulata* in and around the Adirondack Mountains of eastern New York, a distribution that also extends east to the Green Mountains area of Vermont (Bennington Co., Pownal, *A. V. Gilman 6134*, MO).

Erlanson (1934: 251) treated *Rosa relicta* as a synonym of *R.* ×*rudiuscula*, while Steyermark (1954) stated that the species was indistinguishable from *R. arksansana* var. *suffulta* (Greene) Cockerell.

Erlanson considered *Rosa rudiuscula* a hybrid of *R. arkansana* × *R. carolina*, and her decision has generally been followed, but type material including all paratypes are clearly *R. carolina* subsp. *subserrulata* (Lewis, 2008a). Erlanson (1934: 251) included *R. aucuparia* Rydb., *R. bushii* Rydb., *R. conjuncta* Rydb., and *R. relicta* as synonyms of *R.* ×*rudiuscula*. In her key (1934: app. 3, 253), the hybrid is briefly described.

7. Rosa nitida Willd., Enum. Pl. [Willdenow] 1: 544. 1809 [Apr. 1809], syn. nov. *Rosa hispida* var. *nitida* (Willd.) Thory, Prodr. Monogr. Rosier 48. 1820, syn. nov. TYPE: North America. Catalogue No. 9833 [*R. nitida* written on folder, sheet 2a gathering (top) is *Rosa nitida*] (lectotype, designated here, B-W).

The collection is typical of *Rosa nitida* and morphologically conforms to Willdenow's protologue. The two additional gatherings of the three sheets, sheet 2, 2b, and 2c, are syntypes similar to *R. carolina* subsp. *subserrulata*. Sheet 1 with W (lower right) represents an additional syntype, a gathering identified by Crépin as *R. sinica* Murr. Erlanson noted (1929: 479) "that our collection does not contain mature *R. nitida*," but by 1934 (225), significant hybrid data were provided by Erlanson. The species is included in the *Flora of North America* treatment for *Rosa* (Lewis et al., 2012).

8. Rosa palustris Marshall, Arbust. Amer. 1: 135. 1785. TYPE: LINN-Smith Herbarium, Hort. 1812: 901–94 [18th century annotated on sheet] (neotype, designated here, LINN).

Rosa gemella Willd., Enum. Pl. [Willdenow] 1: 544. 1809 [Apr. 1809], syn. nov. *Rosa cinnamomea* L. var. *gemella* (Willd.) Ser. Prodr. [DC.] 2: 605. 1825, syn nov. TYPE: North America, Hort. Bot. Berol., Catalogue 9835 [sheet 1, W left corner, in Willdenow's hand is *R. gemella*] (lectotype, designated here, B-W).

Rosa palustris var. *sepalorelevata* (Schuette) Erlanson, Rhodora 30: 110. 1928, replacement name. Basionym: *Rosa carolina* var. *sepalorelevata* Schuette, Proc. Amer. Assoc. Advancem. Sci. 46: 279, 1898. TYPE: U.S.A. Wisconsin: Brown Co., Ashwaubenon woods, 15 July 1894, *J. H. Schuette s.n.* (lectotype, designated here, GH; isolectotype, US-751574).

Rosa pensylvanica Michx., Fl. Bor.-Amer. (Michaux) 1: 296. 1803. TYPE: U.S.A. New England & Pennsylvania, s.d., *A. Michaux s.n.* (lectotype, designated here, P-MICH-322029).

Rosa palustris, collected by Humphry Marshall (1722–1801) was not found at DWC, where his limited collections are maintained, or at BM, where some material exists (Stafleu & Cowan, 1981: 308). In the absence of original material, which possibly never existed, we selected a neotype from an 18th century collection of *R. palustris* at LINN (Smith Herbarium). What material of *R. palustris* was used by Linnaeus to describe this unnamed species within his concept of *R. carolina* in 1762 remains unknown.

The lectotype of *Rosa gemella* conforms to the description in Willdenow's protologue, and there is no doubt that it is original material. Crépin determined sheet 1 as *R. carolina*, a name then used for *R. palustris*. Although Willdenow noted that *R. gemella* was intermediate between *R. carolina* (*R. palustris*) and *R. lucida* Torrey & Gray (*R. virginiana*, nom. cons.) (Lewis, 2008b), he was probably unfamiliar with *R. palustris*, for the name was not included in his North American roses. The lectotype is clearly *R. palustris*. Erlanson (1934: 250) treated *R. gemella* as a synonym of *R. carolina*, but undoubtedly she had not seen original material in B-W. The syntype, sheet 2, identified as *R. gemella* by Willdenow, is doubtless *R. cinnamomea* as determined by Crépin and also by Lewis in 2008. Seringe also identified the syntype as *R. cinnamomea* and added a variety described as having small (thin) stems somewhat unarmed and stipules mostly narrow. Both characters accurately describe *R. palustris*, and so Seringe correctly separated *R. gemella* (*R. palustris*) from *R. cinnamomea*, which he recognized as distinctly different by describing the new variety. The existence of *R. cinnamomea* in eastern North America prior to Willdenow's publication of 1809 is perhaps the earliest known date of its introduction and naturalization on the continent. The species is recognized in the *Flora of North America* treatment (Lewis et al., 2012).

The lectotype of *Rosa carolina* var. *sepalorelevata* was selected since Schuette wrote on his label that it was the form *sepalorelevata* of "*R. carolina*" (which is *R. palustris*) and also because it conforms morphologically to his brief description, included having upright sepals. This decision also follows Article 7.3 of the Code (McNeill et al., 2006), in which a new name, *R. palustris*, published as an avowed substitute for an older name, is typified by the type of the older name, which is *R. carolina* var. *sepalorelevata*. Erlanson did not recognize the variety in 1934.

Only one collection of *Rosa pensylvanica* was found in the Michaux herbarium at P, but as Michaux cited habitats in swampy places from Pennsylvania to New England, he obviously had seen the species widely and possibly made additional collections. His description and the selected lectotype are typical of *R. palustris*.

Rosa Putative Hybrids and Nothospecies

9. Rosa × engelmannii (S. Watson) Erlanson, pro sp., emend. Bot. Gaz. 96: 250, 258. 1934 [*Rosa acicularis* subsp. *sayi* × *Rosa nutkana* C. Presl subsp. *melina* (Greene) W. H. Lewis & Ertter]. *Rosa engelmannii* S. Watson, Gard. & Forest 2: 376, fig. 121. 1889. *Rosa acicularis* var. *engelmannii* (S. Watson) Rehder, Cycl. Amer. Hort. [L. H. Bailey] 1555. 1902. TYPE: U.S.A. Colorado: Clear Creek Co., above Empire [City], 1881, *G. Engelmann s.n.* (holotype, GH-32571).

Erlanson wrote that "in the Rocky Mountain region there are many forms intermediate between *Rosa nutkana* C. Presl and *R. acicularis*" and "I suspect that *R. engelmannii* S. Watson is a product of such a cross" (1929: 481). The parents are now known as *R. acicularis* subsp. *sayi* × *R. nutkana* subsp. *melina* and are found largely in Colorado and scattered populations of mountainous northern New Mexico, Wyoming, and Montana. Erlanson (1934: 258) first provided the putative hybrid with a brief description (in the key of appendix 3).

10. Rosa ×palustriformis Rydb., pro sp., emend., E. G. Voss, Pap. Michigan Acad. Sci., Part 1. 42: 22. 1957 [*Rosa blanda* Aiton × *Rosa palustris* Marshall]. *Rosa palustriformis* Rydb., N. Amer. Fl. 22: 516. 1918. TYPE: U.S.A. Wisconsin: Brown Co., Green Bay, June 1895, *J. H. Schuette s.n.* (lectotype GH [fl.]; isolectotype, NY-415865).

Rosa blanda var. *nuda* Schuette, Proc. Amer. Assoc. Advancem. Sci. 46: 279. 1898. TYPE: U.S.A. Wisconsin: Brown Co., Dutch Creek, 28 July 1891, *J. H. Schuette s.n.* (lectotype, designated here, US-752280; isolectotypes, F-379305, F-379307, F-379309).

Rosa blanda var. *subgeminata* Schuette, Proc. Amer. Assoc. Advancem. Sci. 46: 279. 1898. TYPE: U.S.A. Wisconsin: Brown Co., Dutch Creek, 2 July 1894, *J. W. Schuette s.n.* (lectotype, designated here, US-752259; isolectotype, K).

Rosa palustris Marshall var. *aculeata* (Schuette) Erlanson, Rhodora 30: 110. 1928, syn. nov. Replacement name: *Rosa carolina* var. *aculeata* Schuette, Proc. Amer. Assoc. Advancem. Sci. 46: 279. 1898. TYPE: U.S.A. Wisconsin: Brown Co., Fort Howard, Elmore Grove, CH & NW railway ditch, 11 Oct. 1891, *J. H. Schuette s.n.* (lectotype, designated here, K).

Rosa palustris Marshall var. *inermis* (Schuette) Erlanson, Pap. Michigan Acad. Sci. 5: 90, 1925, replacement name. Replaced synonym: *Rosa carolina* var. *inermis* Schuette. Proc. Amer. Assoc. Advancem. Sci. 46: 279, 1898, nom. illeg., non *Rosa carolina* var. *inermis* Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 362, 1877. TYPE: U.S.A. Wisconsin: Brown Co., Ashwaubenon, Blesh's farm, 16 July 1897, *J. H. Schuette s.n.* (lectotype, designated here, GH).

Rosa ×michiganensis (Erlanson) Erlanson, pro sp., emend. Bot. Gaz. 96: 259. 1934 [*Rosa blanda* Aiton × *Rosa palustris* Marshall]. *Rosa michiganensis* Erlanson, Rhodora 30: 111. 1928. TYPE: U.S.A. Michigan: Cheboygan Co., Douglas Lake, N Fishtail Bay, dune, 20 Aug. 1924, *C. O. Erlanson & E. W. Erlanson 637* [label *E. W. Erlanson*] (holotype, MICH-1192639; isotypes, IND, MICH-1192640, MICH-1204478,

MICH-1204480 [MICH, all sterile shoots], MO-5472587, MSC, NY).

Rosa ×*schuetteana* (Erlanson) Erlanson, pro sp., emend. Bot. Gaz. 96: 252. 1934 [*Rosa blanda* Aiton × *Rosa palustris* Marshall]. *Rosa schuetteana* Erlanson, Rhodora 30: 112. 1928. TYPE: U.S.A. Michigan: Cheboygan Co., Douglas Lake, near Pine Point, shore thicket, 18 Aug. 1924, *C. O. Erlanson & E. W. Erlanson 629* [label *C. O. Erlanson*] (holotype, MICH-1192641; isotypes, IND, MO-1840524, MSC, NY).

Voss (1957) noted that, as the oldest name, *Rosa* ×*palustriformis* has priority over other hybrid names of Erlanson. The putative parents are *R. blanda* × *R. palustris*. Rydberg selected June 1895 material in flower as type rather than that of August 1899 in fruit (a syntype). Erlanson considered *R. palustriformis* a synonym of *R. blanda* (1934: 250). The hybrid is discussed in the *Flora of North America* treatment for *Rosa* (Lewis et al., 2012).

The lectotype of *Rosa blanda* var. *nuda* was selected as diagnostic of hybrids between *R. blanda* and *R. palustris* and conforms to J. H. Schuette's brief description, although it is somewhat closer to *R. palustris*. Both K and F have a number of similar collections with different collection dates. Erlanson (1934) did not recognize the variety.

The type selected for *Rosa blanda* var. *subgemi-nata* has the fine leaflet serrations of *R. palustris* and upper branches with few, if any, of the prickles of *R. blanda*, characters typical of *R.* ×*palustriformis*. Erlanson (1934) did not recognize the variety.

Type material of *Rosa palustris* var. *aculeata*, replacement name, is typical of *R.* ×*palustriformis* and represents a distribution beyond J. H. Schuette's usual localities. This also follows Article 7.3 of the Code (McNeill et al., 2006) in which a new name published as an avowed substitute for the older name, *R. carolina* var. *aculeata*, is typified by the type of the older name. Erlanson (1934) did not recognize the variety.

Following Article 7.3 of the Code (McNeill et al., 2006), a new name published as an avowed substitute (replacement name) for an older name is typified by the type of the older name. Therefore, type material of the older *Rosa carolina* var. *inermis*, typical of *R.* ×*palustriformis*, is selected as lectotype even though the name is illegitimate, since Articles 7.5 and 58.1 of the Code (McNeill et al., 2006) do not specify that such taxa may not be typified. Therefore, *R. carolina* var. *inermis* Schuette is lectotypified here. Erlanson (1934) did not recognize the variety.

Erlanson noted (1934: 226–227) that *Rosa michiganensis* was rarer in nature than those identified as *R. schuetteana*. Later in appendix 2 (1934: 251), when listing the "Linnaean species," Erlanson recognized *R.* ×*michiganensis* and *R.* ×*schuetteana* as hybrids; in appendix 3 (key, 1934: 252, 259), she provided short descriptions of both nothospecies. They are included as synonyms of *R.* ×*palustriformis* in the *Flora of North America* treatment (Lewis et al., 2012).

Oregon Tetraploid Roses

In 1928, Erlanson, together with H. M. Gilkey, visited the Willamette River Valley about 10 miles south of Corvallis, Oregon, where they found over half-mile-long continuous hedges of *Rosa* (Erlanson, 1930: 126). Present were shrubs of *R. nutkana* intermixed with those of *R. pisocarpa* A. Gray. In addition, nearer Corvallis, they located two large shrubs close to one another that had mixed features of both *R. nutkana* and *R. pisocarpa*. Based on low hip frequencies and aborted ones, they considered the shrubs semisterile hybrids. In 1929, Gilkey sent Erlanson at MICH fixed floral buds taken from shrubs along the *Rosa* hedges for cytological study accompanied with seven herbarium sheets representing vouchers for the bud collections (Erlanson, 1931: 55). Labels on these sheets were written by Erlanson, and each includes cytological results from the buds. All were tetraploids, $2n = 28$. There were no diploid *R. pisocarpa* sheets among the group, and few if any could be considered typical *R. nutkana* (hexaploid). However, some of these tetraploids are undoubtedly hybrids of *R. nutkana* × *R. pisocarpa*.

Acknowledgments. We are indebted to Kanchi Gandhi (GH) for clarifying the use of living material for lectotypifications, Barbara Ertter for comments regarding a variety of *Rosa californica* and typification of the species, Eric Knox (IND) for collaborating with MICH and MO in an exchange of isotypes, Fred Keusenkothen for providing the three images, and Nicholas Turland and Victoria Hollowell for numerous nomenclatural discussions with the first author. We thank reviewer Marshall Crosby and an unidentified reviewer. We are also thankful to the directors, curators, and managers of herbaria at A, B, BM, BR, CAN, CGE, E, F, IND, K, GH, MICH, NDG, NEBC, NY, NYS, and US, which Lewis visited, and those at A, F, GH, MICH, NY, NYS, P, and US, who organized and shipped loan specimens to MO. Thanks, too, to those at MO who are returning these loans.

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Figure 3. Eileen Erlanson (Macfarlane) in 1953. Photo courtesy of W. H. Lewis.

APPENDIX 1. E. W. Erlanson: Biographic notes by W. H. Lewis.

Dr. Erlanson (Macfarlane) was born Eileen Jessie Whitehead in 1899 at Kingston-upon-Thames in southwestern London (Fig. 3). After obtaining her bachelor's degree at the University of London, she moved to Ann Arbor and the University of Michigan in the early 1920s, where she was accepted into the graduate program in botany, which was associated with both the herbarium and botanical garden. She obtained a Ph.D. in 1928 under the guidance of the director of the botanical garden, Harley H. Bartlett. During this time, her interest centered on *Rosa* research, and over the years she established a major living collection of North American species at the garden, which, together with field research largely in the Midwest and California, formed the basis for long-term hybridization and cytological programs. She published prolifically during this time, her efforts culminating in a long and important paper in 1934 that synthesized her research and set the groundwork for the taxonomic revision of *Rosa* species, which was based not only on morphology but also on cytological work—then in its infancy—and by using results of hybrid crossings and their progeny, pollen analyses, and other techniques. Based on this outstanding research, Dr. Erlanson received a D.Sc. degree (in 1934) from the University of London. During the 1930s, Dr. Erlanson went to India to conduct research largely on health-related issues, then to Ohio to continue her research in cancer and toxicology at the Institutum Divi Thomae Foundation in Cincinnati. After completing my Master's thesis in 1953 at the University of British Columbia on Roses of the Pacific Northwest, I moved to the University of Virginia as a DuPont Fellow to continue research on *Rosa*. A year later I contacted Dr. Erlanson about my rose research project and, following our correspondence and discussions, she donated a set of living species and interspecific hybrids to the Blandy Experiment Farm, a botanical field station of the University of Virginia, for planting and my use in research. In 1955, my mentor, Dr. Walter Flory, and I traveled to the University of Michigan Botanical Garden, where Dr. Erlanson had organized several large batches of duplicate plants for transport to the Blandy field station. These living collections were enormously valuable for my initial comprehensive study of rose species east of the Rocky Mountains, which led to a Ph.D. in 1957. Collections made from these plantings are mostly available at the Missouri Botanical Garden Herbarium and so continue as an important resource for my renewed *Rosa* research. It still amazes me that someone with the research stature of Dr. Erlanson could have given so much time and effort to one graduate student. After graduation we kept in contact: I

named a rose variety after her, and in 1981 Dr. Erlanson accepted an invitation to visit us in St. Louis, appropriately over the Thanksgiving holiday, and these few days gave us another opportunity to discuss rose research further. The visit also allowed us to describe the new, long-term, ethnobotanical project in Amazonian Peru that my wife, Dr. Memory Elvin-Lewis, and I would undertake from 1982 until 2001. The whole project interested her greatly, as anyone who knew Dr. Erlanson would understand. Those few memorable days proved to be the last time we were together, for Dr. Erlanson died in 2003 among her family at Wheeling, West Virginia, at the age of 104.

I extend my sincerest appreciation to Dr. Erlanson (Macfarlane's) nephew, Jeremy C. McCamic, J.D., who kindly shared information on their family history and her final days in West Virginia.

Neuwiedia malipoensis, a New Species (Orchidaceae, Apostasioideae) from Yunnan, China

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Abstract. *Neuwiedia malipoensis* Z. J. Liu, L. J. Chen & Ke Wei Liu (Orchidaceae, Apostasioideae), from southeastern Yunnan Province in China, is described, illustrated, and photographed. The new species is characterized by a true corolla lip, which is widely obovate and concave, with a subterete claw at the base and a fleshy linear callus extending from its claw to the upper portion. By these features it can be easily distinguished from its allied *N. veratrifolia* Blume, *N. balansae* Baill. ex Gagnep., and other species of this genus.

Key words: Apostasioideae, China, IUCN Red List, *Neuwiedia*, Orchidaceae, Yunnan.

Neuwiedia Blume is a genus within the subfamily Apostasioideae (Orchidaceae) for which 17 names have been described. Approximately 10 species are distributed across southeastern Asia from southern China through Southeast Asia to New Guinea and the Pacific Islands. Only the one species, *N. singapureana* (Wall. ex Baker) Rolfe, has been reported for the Chinese flora (Chen, 1999). The flowers of this genus are nearly actinomorphic, with three fertile stamens and a simple lip similar to, but a little larger than, the remaining two petals; the lip's midrib is usually raised on the upper surface.

The new taxon was collected from southeastern Yunnan Province in China during fieldwork in 2008. It is similar in habit and floral morphology to other *Neuwiedia*, except that the corolla lip consists of a concave, widely obovate blade with a subterete claw at the base, and a fleshy linear callus that is both 1 mm wide and high and extends from its claw to the upper part of the corolla blade. This lip is quite distinct from the other two petals and the flowers are obviously zygomorphic in appearance, in contrast to other species in the genus. This undescribed species represents an advanced type in the genus. The lip structure easily distinguishes the new species from the allied *N. veratrifolia* Blume and *N. balansae* Baill. ex Gagnep., as well as other species of the genus.

The living plants and ecological environment were observed in the field in Malipo County (ca. 23°N) in southeast Yunnan, China, in August 2008. Fresh flowers were examined under a stereoscope (Guiguang XTL-500, Guilin, China). Comparison of the vegetative and floral structures was made between this taxon and *Neuwiedia veratrifolia* and allies based on fresh material, herbarium specimens, and the available literature.

Neuwiedia malipoensis Z. J. Liu, L. J. Chen & Ke Wei Liu, sp. nov. TYPE: China. Yunnan: Malipo, Ma An Shan, 1100 m, evergreen broad-leaved forest, limestone mountainous area, 1100 m, 11 Aug. 2008, *Z. J. Liu 4058* (holotype, NOCC). Figures 1, 2.

Species nova *Neuwiediae veratrifoliae* Blume et *N. balansae* Baill. ex Gagnep. similis, sed a priore floribus praeter callum flavum labelli albis atque labello late obovato concavo basi subtereti-unguiculato, a posteriore foliis multo longioribus 30–63 cm (10–20 cm in *N. balansae*) longis, petiolo 12–20 cm (3–10 cm in *N. balansae*) longo atque labelli callo lineari carnoso ab basi unguis ad 2/3 longitudinis laminae (ad apicem in *N. balansae*) extenso differt.

Terrestrial plants 65–70 cm tall; rhizome 13–15 cm, 1.5–1.7 cm diam., with evident nodes, bearing stout roots. Leaves many, nearly tufted on the short stem; leaf blades oblong to lanceolate, 30–63 × 3.3–4.8 cm, apex long-acuminate; petiole 12–20 cm, margin membranous, base slightly dilated and

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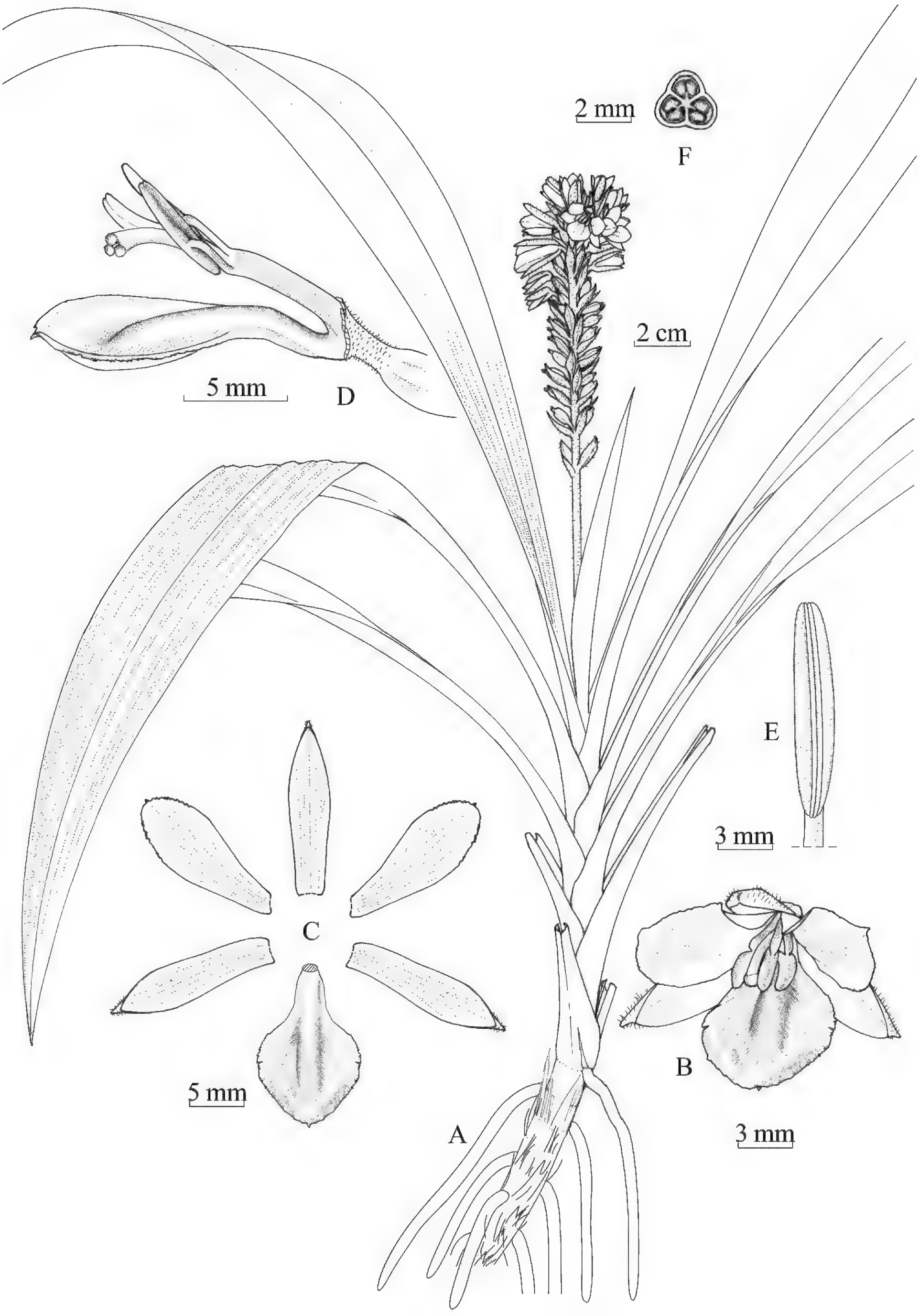

Figure 1. *Neuwiedia malipoensis* Z. J. Liu, L. J. Chen & Ke Wei Liu. —A. Fertile plant habit, with both flowers and fruits. —B. Intact flower (front view). —C. Dissected flower, showing the dorsal sepal, two petals, two lateral sepals, and the lip. —D. Lip and column (lateral view), with the sepals and petals removed. —E. Anther. —F. Capsule cross section. A–F drawn by X. Y. Ma from the holotype *Liu 4058* (NOCC).

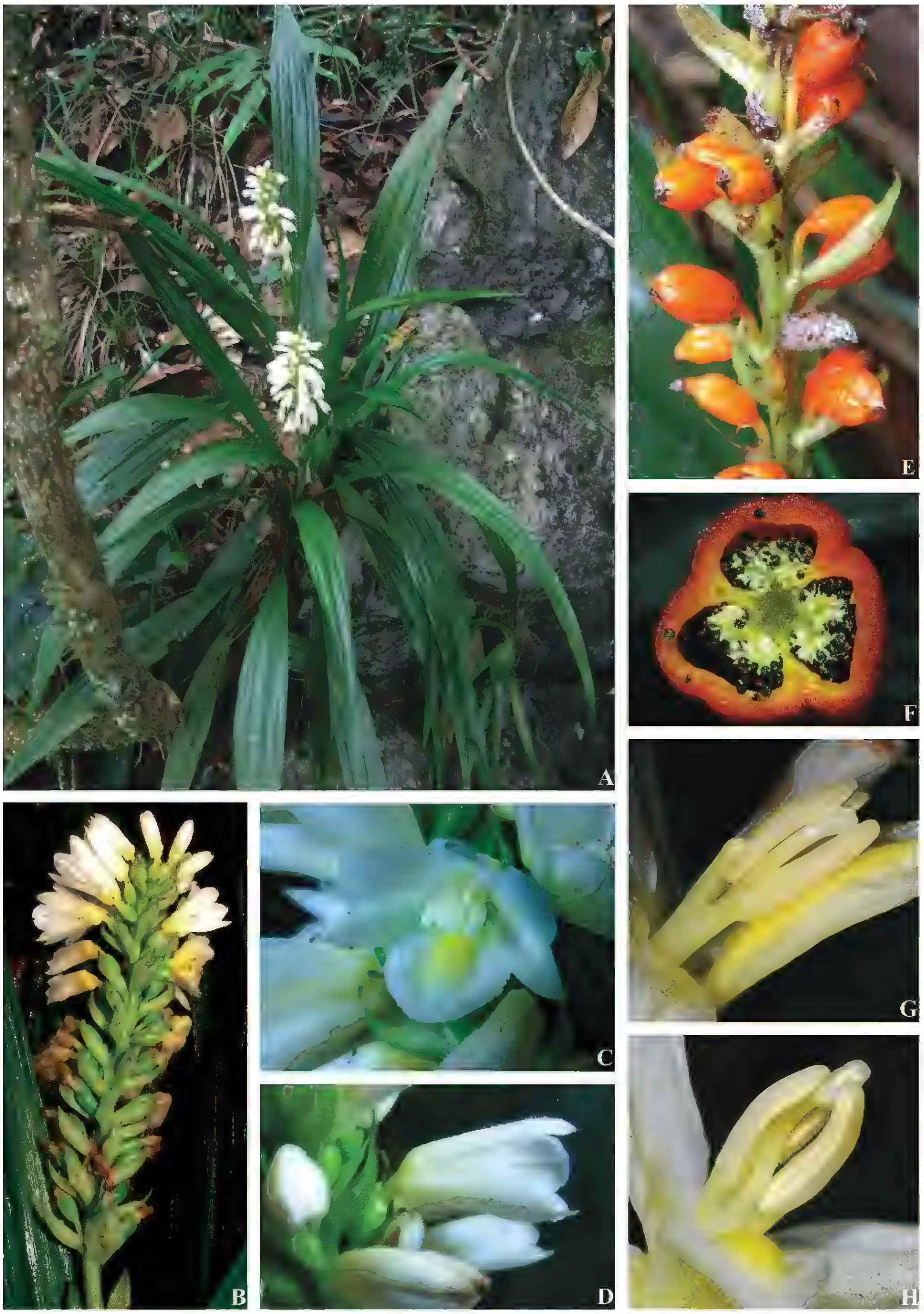

Figure 2. *Neuwiedia malipoensis* Z. J. Liu, L. J. Chen & Ke Wei Liu. —A. Fertile plants at the type locality in Malipo, Yunnan. —B. Close-up of inflorescence. —C. Flower (front view). —D. Flowers (side view). —E. Infructescence. —F. Capsule cross section. —G. Close-up of column in flower (side view). —H. Close-up of anthers and style (side view). A–H taken by L. J. Chen from the type locality from the original population collected.

clasping. Scape to 35 cm; raceme ca. 11 cm, 20-flowered or more; rachis, with glandular trichomes; floral bracts ovate to lanceolate, 1–1.7 cm, abaxially with glandular trichomes. Flowers not resupinate, white, except for the yellow linear callus on the lip, not opening widely; sepals narrowly elliptic, 1.6–1.9 × 0.35–0.4 cm, hooded apically, shortly aristate toward abaxial apex, abaxially with glandular trichomes, dorsal sepal usually slightly smaller than lateral pair; petals broadly cuneate, obovate, 1.6–1.8 × 0.5–0.6 cm, apex mucronate, abaxially sparsely glandular pubescent; labellum bipartite; blade ± widely obovate, concave, margins erose, base narrowing into a subterete claw, with a fleshy linear callus extending from the base of the claw distally for 2/3 of the blade length; column erect, 10–11 mm; stamens subequal to stigma; filaments 3.3–3.7 × 0.6–0.7 mm; anthers linear, 5.8–6.2 mm; ovary elliptic, 7–8 mm; style 6–6.5 mm, subterete; stigma 3-lobed. Immature capsule ellipsoid.

Phenology. *Neuwiedia malipoensis* was observed in flower from July to August at the type locality.

Habitat and ecology. *Neuwiedia malipoensis* was observed to grow in wet places in a pristine evergreen broad-leaved forest on a limestone slope at the southern fringe of a subtropical zone at an elevation of ca. 1100 m. The dominant plant associates include trees and shrubs such as *Zanthoxylum armatum* DC. (Rutaceae), *Luculia pinceana* Hook. (Rubiaceae), *Brassaiopsis glomerulata* (Blume) Regel (Araliaceae), *Machilus rufipes* H. W. Li (Lauraceae), *Ficus hirta* Vahl var. *imberbis* Gagnep. (Moraceae), *Trevesia palmata* (Roxb. ex Lindl.) Vis. (Araliaceae), *Cornus oblonga* Wall. (Cornaceae), and *Rubus paniculatus* Sm. (Rosaceae). Herbaceous associates include *Liparis delicatula* Hook. f. and *L. assamica* King & Pantl. (Orchidaceae), *Debregeasia orientalis* C. J. Chen, *Elatostema pachyceras* W. T. Wang, *Pilea glaberrima* (Blume) Blume, and *P. howelliana* Hand.-Mazz. (Urticaceae), *Impatiens arguta* Hook. f. & Thomson (Balsaminaceae), *Cynoglossum zeylanicum* (Vahl ex Hornem.) Thunb. ex Lehm. (Boraginaceae), *Artemisia indica* Willd. (Asteraceae), *Galium asperuloides* Edgew. subsp. *hoffmeisteri* (Klotzsch) H. Hara (Rubiaceae), *Microsorum superficiale* (Blume) Ching (Polypodiaceae), and *Glaphyropteridopsis erubescens* (Wall. ex Hook.) Ching (Thelypteridaceae).

The type locality is in a subtropical highland in the monsoon region, with an average annual temperature of 17.6°C, ranging from 10.1°C to 23°C. The canopy density was estimated at 80%–85% coverage. The dry season extends from December to March, when there is no fog, and the rainy season is from April to November, when this area is often covered by dense fog in the night and morning (Liu et al., 2008a, 2008b). The soil types are mainly developed from limestone, and the soil layer is rather thin. The vegetation in this area consists of broad-leaved forests, coniferous forests, thickets, and grasslands (Liu et al., 2008a, 2008b).

IUCN Red List category. This species is very rare. There were altogether 97 individuals found exclusively in six populations. We failed to see more plants in the vicinity of the type locality at Malipo, and this location is often threatened by human activity. The conservation status of this new species is assessed as Endangered (EN), according to IUCN (2001) criteria.

Discussion. In comparison to derived taxa in the other four subfamilies of the Orchidaceae, *Neuwiedia* of the Apostasioideae is a rather primitive genus, from whose allies or ancestors the Orchidaceae may have derived in a past paleogeologic period (Kocyan et al., 2004). The Apostasioideae remains a poorly known subfamily, with only the two genera *Neuwiedia* and *Apostasia* Blume. *Neuwiedia* is distinguished from *Apostasia* by its three fertile stamens with fairly long filaments, versus two stamens, with or without a central staminode, with short filaments adnate to the style in *Apostasia*. The stigma is trilobed in *N. malipoensis*, but noted as capitate in *Apostasia* (Chen, 1999; Chen et al., 2009).

The typical perianth of *Neuwiedia* is somewhat zygomorphic in appearance, with the lip slightly larger than the lateral two petals; the midvein of the lip is usually raised on the upper surface. The perianth of the new species shows a strong zygomorphic tendency and the central petal, or lip, is more or less differentiated into a short subterete claw and a widely obovate, concave blade. On its upper surface there is a fleshy linear callus extending from the base of the claw distally for two-thirds of the blade length. This makes the flowers more clearly zygomorphic in appearance, and there is no doubt they are most derived within the genus.

This new species is quite different from *Neuwiedia singapureana*, the only species of this genus found in China, which has a lip similar in shape and size to the two lateral petals except for the midvein raised on the upper surface. Our new plant is somewhat similar to *N. veratrifolia* and *N. balansae*. *Neuwiedia veratrifolia* has yellow flowers, and the lip lacks a terete claw at the base, while *N. balansae* has smaller leaves, only 10–20 cm long, with shorter petioles 3–10 cm long, and the fleshy linear callus on the lip

extends from a sessile base to its apex. *Neuwiedia balansae* has been reduced by some authors to a synonym of *N. singapureana* (Seidenfaden, 1992; Chen, 1999; Chen et al., 2009), but was treated by Averyanov (2008) as a variety of *N. zollingeri* Rchb. f., as *N. zollingeri* var. *balansae* (Baill. ex Gagnep.) Aver.

The occurrence of *Neuwiedia malipoensis* in Malipo is of phytogeographic interest. Malipo County is located in southeast Yunnan Province in China, where many tropical and subtropical plants converge with temperate plants. In the Orchidaceae, the following exemplary taxa mix in this region: the temperate *Cypripedium malipoense* S. C. Chen & Z. J. Liu (Chen & Liu, 2004), the northern and subtropical *Ypsilorchis fissipetala* (Finet) Z. J. Liu, S. C. Chen & L. J. Chen (Liu et al., 2008b), the southern Vietnamese *Paphiopedilum delenatii* Guillaumin (Averyanov et al., 2003) and the southeastern Asian *Liparis gibbosa* Finet (Shui & Chen, 2006). Malipo and adjacent counties in southeast Yunnan are characterized by a karst topography, with numerous limestone peaks. The area is richly diverse in its flora, particularly so for orchids, with no less than 200 species of orchids recorded (Chen & Tsi, 1997; Li, 2003; Shui & Chen, 2006), many of which are recent discoveries and include *Phalaenopsis malipoense* Z. J. Liu & S. C. Chen, *Cypripedium singchii* Z. J. Liu & L. J. Chen, *Cypripedium malipoense* S. C. Chen & Z. J. Liu, and *Cheirostylis malipoensis* X. H. Jin & S. C. Chen.

Paratype. CHINA. **Yunnan:** Malipo Co., Ma An Shan, 1000 m, 20 July 2010, *Z. J. Liu 5050* (PE).

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Erythroxylum ayrtonianum (Erythroxylaceae): A New Species from Brazil

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ABSTRACT. A new species assigned to *Erythroxylum* sect. *Rhabdophyllum* O. E. Schulz is described and illustrated under the name of *E. ayrtonianum* Loiola & M. F. Sales. This new species resembles *E. pelleterianum* A. St.-Hil. in the general aspect of its leaves and the flexuous, slender branches, but differs by its distichous cataphylls distributed along the short branches and the leaves with wavy to strongly wavy margins. *Erythroxylum ayrtonianum* is reported from savanna formations (cerrado vegetation) in the north-central portion of Brazil, with the type locality from the state of Tocantins.

Key words: Brazil, Erythroxylaceae, *Erythroxylum*, IUCN Red List, savanna formations.

South America is one of the main centers of diversity and endemism of *Erythroxylum* P. Browne (Erythroxylaceae), where 114 (64.9% endemic) and 34 (11.8% endemic) species are found in Brazil and Venezuela, respectively (Plowman & Hensold, 2004; Loiola, 2011). According to Loiola (2001, 2011) and Loiola et al. (2007), the *Erythroxylum* species in Brazil are found in humid forests, such as the Amazon and Atlantic communities, as well as drier vegetation types such as semi-arid scrub forest (caatinga) and savanna formations (cerrado). Northeastern Brazil boasts the greatest diversity and the largest number of taxa endemic to the country, with several new species described recently (Plowman, 1983, 1986, 1987; Loiola & Sales, 2008).

During taxonomic analysis of herbarium materials for the monograph of *Erythroxylum* sect. *Rhabdophyllum* O. E. Schulz for *Flora Neotropica*, a new species was discovered from the cerrado of Tocantinópolis and Ilha do Bananal (both in Tocantins) and Imperatriz (Maranhão, Brazil). The new taxon is described and illustrated here.

Erythroxylum ayrtonianum Loiola & M. F. Sales, sp. nov. TYPE: Brazil. Tocantins: Tocantinópolis, Ribeirão do Córrego, 55 km SW of Estreito along Belém–Brasília hwy. (BR 153), 6°49′S, 47°49′W, 27 Feb. 1980 (lf.), *T. Plowman, G. Davidse, N. A. Rosa, C. S. Rosário & M. R. dos Santos 9210* (holotype, F; isotypes, MO not seen, NY). Figure 1.

Haec species foliorum laminis ellipticis et ramulis flexuosis tenuibus *Erythroxylo pelleteriano* A. St.-Hil. affinis, sed ab eo foliis membranaceis (vs. chartaceis) marginibus undulatis (vs. planis), cataphyllis ramorum brevium congestis (vs. paucis) distichis, stipulis 2–3 mm (vs. 3–4 mm) longis et pedicellis ca. 2.5 mm (vs. 4–10 mm) longis differt.

Shrubs or small trees 0.8–8 m, with open, spreading crown and storied branches; lenticels absent; bark thin, reddish brown, longitudinally fissured or exfoliating in thin flakes; branches light gray; branchlets slender, 1–2 mm diam., arranged alternately, diverging 45° or 90° from axis, finely striate, terete, flexuous, light brown and flattened; new twigs mustard yellow or reddish brown; numerous short branches; internodes 10–45 mm long. Cataphylls congested and present along short shoots and produced at base of new shoots for 7–15 mm, distichous, persistent, similar to stipules, yellowish when young, brown when older; spinule 0.5–1.5 mm, darkened, pointed; stipules 2–3 × 1.2–1.8 mm, triangular, rounded at apex, clearly striate-nerved, with 5 or 6 parallel nerves per side, margin markedly erose when young, entire when mature, the setae lacking or rarely with 3, the 2 lateral setae ca. 0.7 mm, the medial seta ca. 1 mm; keel prominent, riblike; petiole 1–4.5 × 0.4–0.6 mm, subterete, sulcate adaxially; leaf blades 2.4–6.6 × 1.3–3 cm, membranous, sometimes deciduous, elliptic, acute at apex, acute at base, margin undulate or strongly undulate, slightly discolorous, somewhat shiny, medium green, dull adaxially, glaucous dull pale green abaxially, the midrib obscure adaxially, prominent abaxially, with 9 to 11 secondary nerves on each side, the veinlets very finely reticulate, most evident on lower leaf surface. Inflorescences as fascicles reduced to one flower, in

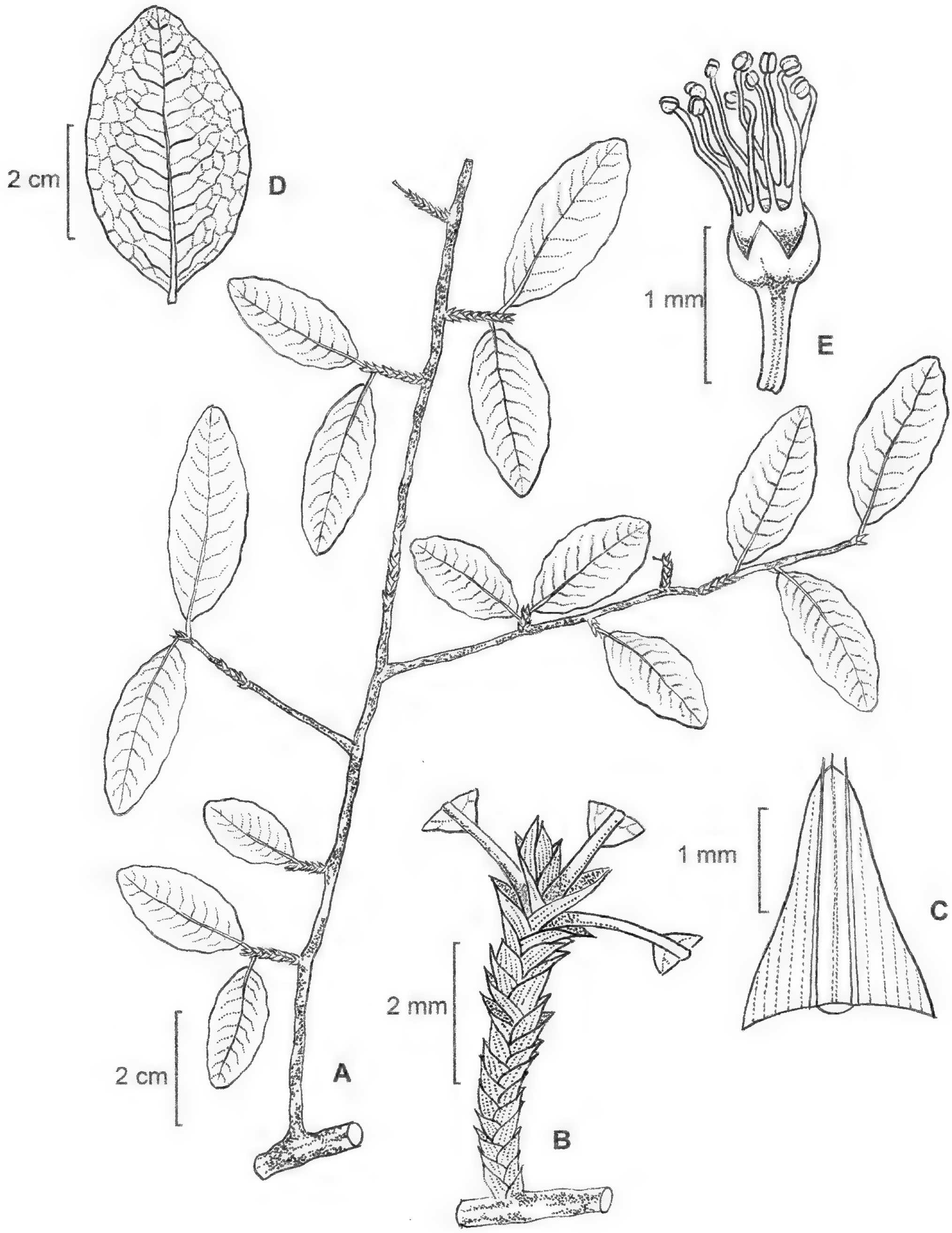

Figure 1. *Erythroxylum ayrtonianum* Loiola & M. F. Sales. —A. General view of a branch. —B. Detail of branch showing cataphylls and stipules. —C. Stipule, showing three apical setae. —D. Detail of the leaf, adaxial surface. —E. Brachystylous flower, showing the stamen tube. A–D drawn from the holotype *Plowman et al. 9210* (F); E from *J. A. Ratter et al. 4414* (F).

axils of cataphylls; bracteoles not seen; buds not seen. Flowers with pedicel ca. 2.5 mm, 5-angled, greenish white; calyx 2–2.2 × 2.2–3 mm; lobes 1–1.2 × 0.5–0.6 mm, triangular; petals not seen; staminal cup 0.7–0.8 × 1–1.2 mm, smaller than calyx, margin entire; brachystylous flowers with filaments 2.2–2.8 mm; anthers 0.4 × 0.3 mm, oblong to cordiform; styles not seen; ovary ca. 0.8 × 0.7 mm, ellipsoid. Dolichostylous flowers not seen. Drupe not seen.

Distribution, habitat, and ecology. The new species has a narrow geographic range, between 6°S and 10°S latitude and 47°W and 50°W longitude. *Erythroxylum ayrtonianum* occurs in the cerrado in Tocantins and Maranhão states, in north-central Brazil, at elevations between 290 and 480 m. In Tocantinópolis (Tocantins), it was found in a low gallery forest along a stream, in an area of sandstone rocks and sandy soils. Some populations of this species occur in protected areas in Bananal Island, localized within a conservation area, the Araguaia National Park in the state of Tocantins.

IUCN Red List category. *Erythroxylum ayrtonianum* should be considered Least Concern (LC), according to IUCN Red List criteria (IUCN, 2001).

Phenology. The new species was collected in flower (mature) in September.

Etymology. The specific epithet *ayrtonianum* honors Ayrton Amaral Jr. of the Universidade Estadual de São Paulo, Campus Botucatu, São Paulo, Brazil, specialist in the systematics of *Erythroxylum*.

Discussion. *Erythroxylum ayrtonianum* is included in *Erythroxylum* sect. *Rhabdophyllum* because of its striate-veined stipules and triangular calyx lobes. The taxon is very similar to two other species of this section (*E. pelleterianum* A. St.-Hil. and *E. buxus* Peyr) in the overall aspect of the leaves and with respect to geographic distribution in that the three species are found in cerrado. However, these taxa can be separated by the combination of markings observed on their leaves, stipules, and flowers.

Erythroxylum ayrtonianum shares with *E. pelleterianum* elliptic leaves and the flexuous, slender branches. However, the new taxon differs from the former by the leaf being membranous when mature (vs. chartaceous when mature), stipule length (2–3 mm vs. 3–4 mm), number of setae on stipules (three or none vs. three), number of secondary nerves on each side of leaf (nine to 11, most evident on lower leaf surface vs. 11 to 16, evident on both sides of the leaf) and pedicel lengths (ca. 2.5 mm vs. 4–10 mm).

Erythroxylum ayrtonianum is similar to *E. buxus* in the membranous leaf texture. The latter differs by its leaf form (elliptic vs. obovate), by the number of striations on stipules and cataphylls (five or six vs. six to nine nerves), and by pedicel length (ca. 2.5 mm vs. 8–15[20] mm). Uniquely distinctive characteristics for *E. ayrtonianum* are the distichous cataphylls present along the length of the short branches and/or at the base of new branchlets, as well as the leaves with wavy to strongly wavy margins.

Paratypes. BRAZIL. **Maranhão:** Imperatriz, "Bananal," 15 km S of Imperatriz along Belém–Brasília hwy. (BR 010), ca. 5°40′S, 47°26′W, 29 Feb. 1980 (lf.), *T. Plowman, G. Davidse, N. A. Rosa, C. S. Rosário & M. R. dos Santos 9348* (INPA, MG, MO not seen, NY). **Tocantins:** Ilha do Bananal, Parque Nac. Araguaia (IBDF), near HQ (ca. 2 km from Macaúba, ca. 10°30′S, 50°30′W, 15 Sep. 1980 (lf., fl.), *J. A. Ratter, M. P. Rocha & R. A. de Castro 4414* (F); Tocantinópolis, Ribeirão do Córrego, 55 km SW of Estreito along Belém–Brasília hwy. (BR 153), 6°49′S, 47°49′W, 27 Feb. 1980 (lf.), *T. Plowman, G. Davidse, N. A. Rosa, C. S. Rosário & M. R. dos Santos 9206* (NY), *9207* (F, MO not seen, NY), *9208* (F, FLAS, GH, MICH, MO not seen, NY, UC, WIS), *Plowman et al. 9215* (MO not seen, NY).

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Psychotria kosraensis (Rubiaceae), a New Species from Kosrae, Caroline Islands, Micronesia

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ABSTRACT. *Psychotria kosraensis* Lorence & K. R. Wood (Rubiaceae, Rubioideae), a narrow endemic from Kosrae, Caroline Islands, Federated States of Micronesia (FSM), is described and illustrated. The new species differs from other known species of *Psychotria* L. in Micronesia by its combination of narrowly obovate-elliptic or narrowly elliptic leaves with long-acuminate apex and abaxially barbate leaf axils, pseudoaxillary fasciculate inflorescences with very short peduncles ca. 1 mm, flowers with a long calyx tube with narrowly triangular lobes, and villosulous fruits crowned with the persistent well-developed calyx tube and lobes. Known from a single population of five individuals, *P. kosraensis* easily falls into the IUCN Red List category of Critically Endangered (CR).

Key words: Federated States of Micronesia, IUCN Red List, Kosrae, *Psychotria*, Rubiaceae.

Kosrae (formerly known as Kusaie or Kusae) is located in the eastern Caroline Islands at 5°20′N longitude and 163°0′E latitude (Fig. 1). It is one of four states comprising the Federated States of Micronesia (FSM). This volcanic high island covers an area of ca. 110 km² (41.7 sq. mi.) and rises to an elevation of ca. 634 m (2080 ft.) at Mt. Finkol. The oldest rocks from Kosrae date to ca. 2.6 Ma (Duncan & Clague, 1985). No checklist or flora of Kosrae exists, although Fosberg and collaborators have published checklists of Micronesian plant groups (Fosberg et al., 1979, 1982, 1987) and five fascicles of an incomplete *Flora of Micronesia* (Fosberg & Sachet, 1975a, 1975b, 1977, 1980a; Fosberg et al., 1993). Recent botanical inventory work conducted on Kosrae by staff of the National Tropical Botanical Garden, The New York Botanical Garden, and the Kosrae Conservation and Safety Organization (KCSO) has increased our knowledge of the island's flora, including numerous island records of native and introduced species and a comprehensive checklist currently in preparation. This work has resulted in the discovery of the following new species of *Psychotria* L., which is described below.

Psychotria kosraensis Lorence & K. R. Wood, sp. nov. TYPE: Federated States of Micronesia. Caroline Islands: Kosrae, Lelu Municipality, Finol (Mt.) Mutunte, NE slopes, 520 m, 6 Feb. 2010, *K. R. Wood, W. Law, C. Cianchini & J. Sanney 14132* (holotype, PTBG-051673 [inflor., fl. in packet]; isotypes, MO [fr.], NY [fr.], PTBG-051672 [st., note stipule], US [buds]). Figure 2.

Haec species a congeneris micronesianis foliis anguste obovato-ellipticis vel anguste ellipticis apice longe acuminatis abaxialiter ad axillas venarum secundariarum barbatis, stipulis vaginantibus tubularibus caducis vagina 30–35 mm longa ac lobis bifidis, inflorescentia condensata pseudoaxillari 3- ad 9-flora pedunculo ca. 1 mm longo insidente atque fructu (immaturo) ellipsoideo villosulo 5–5.5 mm longo 3–3.5 mm diam., calycis tubo 1.7–1.8 mm longo ac lobis anguste triangularibus 1.2–1.8 mm longis coronato distinguitur.

Small trees 1–2 m tall, moderately branched, leafy stems dark brown with red-brown tinge, 2.5–3.5 mm diam., compressed, glabrous except for ring of reddish brown colleters at stipule scars, internodes 1.5–3.5 cm. Leaves with the blade narrowly obovate-elliptic to narrowly elliptic, (9–)16–19 × (3–)3.7–5.3 cm, when fresh, blades glossy dark green with secondary veins impressed, paler beneath, drying green or brownish green with costa and veins stramineous, base narrowly cuneate, apex long-acuminate, secondary veins in 12 to 14 pairs, festooned brochidodromous, barbate in axils abaxially with brown trichomes, margins plane; petioles 1.5–2.2 cm, 1–1.3 mm diam., glabrous; stipules cylindrical-sheathing, thin, brown, glabrous, splitting down one side and soon deciduous; sheath 30–35 mm, 4 mm diam., apex bilobed with lobes 10–12 mm, each lobe deeply bifid for 5–6 mm. Inflorescence apparently terminal but soon becoming pseudoaxillary by displacement, at first enclosed by a caducous stipule-like bract, fasciculate, 3- to 9-flowered, subsessile or the peduncle to 1 mm, subtended by 1 or 2 bracts ca. 4 mm with apex acuminate. Flowers on villosulous pedicels ca. 1 mm, 0.5–0.7 mm diam., hypanthium obconic, 1–1.2 mm, villosulous; calyx tube 1.7–1.8 mm, obconic, glabrous externally, calyx lobes 5, narrowly triangular, 1.2–1.8

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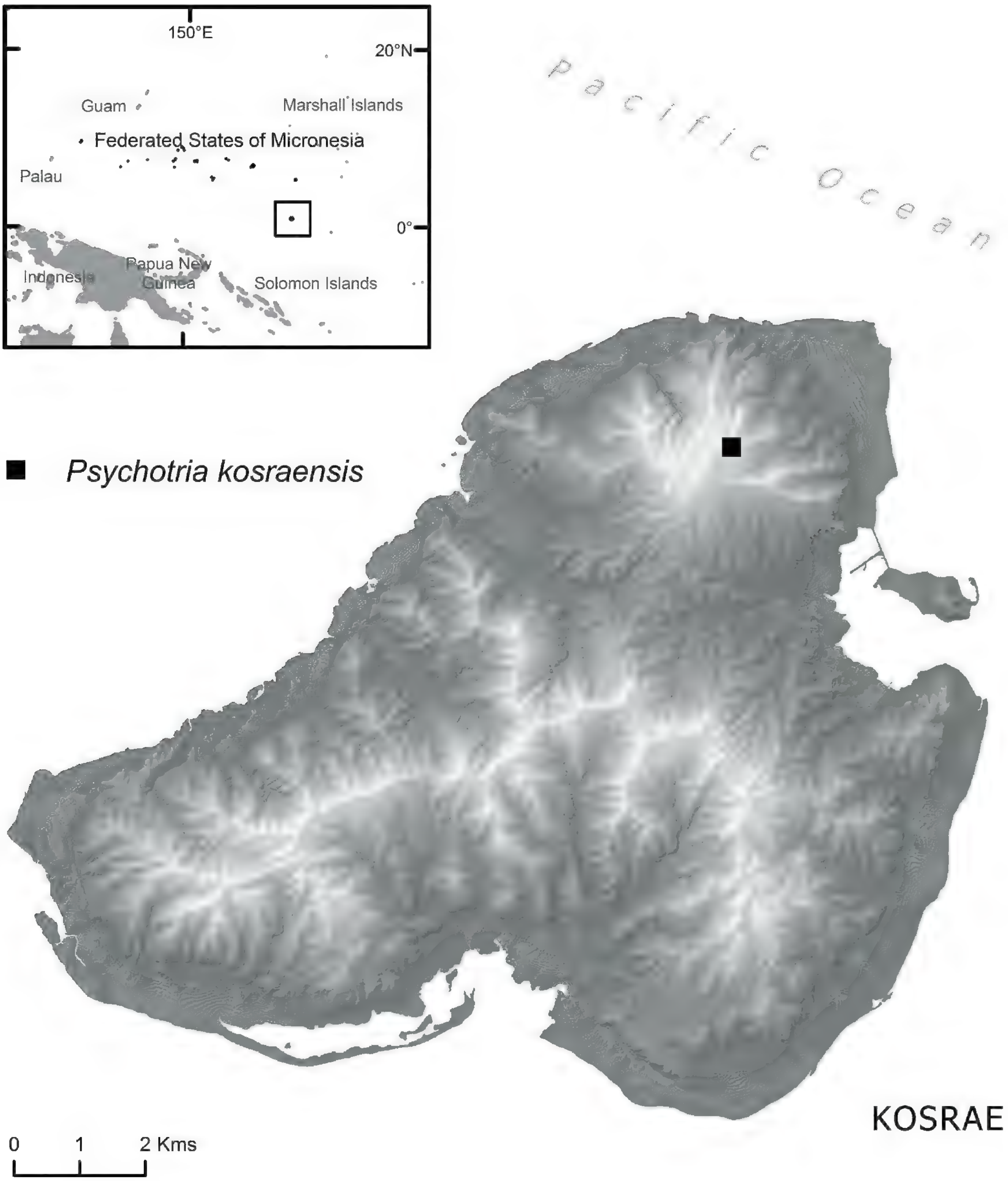

Figure 1. Location of *Psychotria kosraensis* Lorence & K. R. Wood on Mt. Mutunte, Kosrae, Federated States of Micronesia.

× 0.5–0.7 mm, apex acute; corolla white, funnelform, externally glabrous, internally villous in throat, tube 5–6 mm, lobes 4.5–5 × 1.2–1.3 mm, recurved; stamens partly exserted, filaments 2 mm, anthers ellipsoid, 2 mm, style 10 mm, exserted, glabrous, stigma bilobed, lobes 0.7 mm, papillose. Fruits (immature) light green, ellipsoid, 5–5.5 × 3–3.5 mm, villosulous, dorsally ribbed, crowned by persistent calyx; pyrenes not seen.

Distribution, habitat, and phenology. *Psychotria kosraensis* is known only from the steep upper northeastern slopes of Mt. Mutunte in the Lelu Municipality of northern Kosrae at 520 m. This habitat is low-elevational cloud forest rich with terrestrial and epiphytic bryophytes and a closed canopy of trees and shrubs. Associates include *Polyscias subcapitata* Kaneh. (Araliaceae), *Ponapea ledermanniana* Becc. (Arecaceae), *Elaeocarpus carolinensis* Koidz. and *E.*

Figure 2. Holotype of *Psychotria kosraensis* Lorence & K. R. Wood, showing branch with terminal inflorescence and dissected flower (*Wood et al. 14132*, PTBG).

kusaiensis Kaneh. (Elaeocarpaceae), *Flagellaria indica* L. (Flagellariaceae), *Cyrtandra kusaimontana* Hosok. and *C. urvillei* C. B. Clarke (Gesneriaceae), *Neuburgia celebica* (Koord.) Leenh. (Loganiaceae), *Astronidium carolinense* (Kaneh.) Markgr., *Medinilla diversifolia* Kaneh., and *Melastoma malabathricum* L. (Melastomataceae), *Ficus virens* Aiton (Moraceae), *Horsfieldia irya* (Gaertn.) Warb. (Myristicaceae), *Pandanus kusai-*

colus Kaneh. and the woody climber *Freycinetia ponapensis* Martelli (Pandanaceae), *Ixora casei* Hance, *Psychotria hombroniana* (Baill.) Fosberg, and *P. rhombocarpa* Kaneh. (Rubiaceae), *Planchonella micronesica* (Kaneh.) Kaneh. ex H. J. Lam (Sapotaceae), and *Boehmeria virgata* (G. Forst.) Guill. and *Pipturus argenteus* (G. Forst.) Wedd. (Urticaceae). The lower stratum and ground flora include sedges such as *Hypolytrum dissitiflorum* Steud. and *Mapania pandanophylla* (F. Muell.) K. Schum. subsp. *immensa* (Kük.) T. Koyama (Cyperaceae) and numerous ferns and lycophytes including *Asplenium robustum* Blume and *A. pellucidum* Lam. (Aspleniaceae), *Sphaeropteris lunulata* (Forst.) R. M. Tryon and *S. nigricans* (Mett.) R. M. Tryon (Cyatheaceae), *Davallia solida* (G. Forst.) Sw. and *D. repens* (L. f.) Kuhn (Davalliaceae), *Histiopteris incisa* (Thunb.) J. Sm. (Dennstaedtiaceae), *Bolbitis heteroclita* (C. Presl) Ching, *Dryopteris hasseltii* (Blume) C. Chr., and *Elaphoglossum carolinense* Hosok. (Dryopteridaceae), *Huperzia phlegmaria* (L.) Rothm. (Lycopodiaceae), *Angiopteris evecta* (G. Forst.) Hoffm. (Marattiaceae), *Pteris pacifica* Hieron. (Pteridaceae), *Tectaria grandifolia* (Pr.) Copel. (Tectariaceae), *Cyclosorus heterocarpus* (Blume) Ching (Thelypteridaceae), and *Diplazium melanocaulon* Brack. (Woodsiaceae).

Two of the five known trees of *Psychotria kosraensis* were observed in early flower and fruit in February 2010 but were sterile in September 2011.

IUCN Red List Category. When evaluated using the World Conservation Union (IUCN) criteria for endangerment (IUCN, 2001), *Psychotria kosraensis* falls into the Critically Endangered (CR) category, which designates this species as facing the highest risk of extinction in the wild: B1ab(v); B2a, B2b(i–iii); D: B1, extent of occurrence less than 100 km^2, B1a, known to exist at only a single location, B1b(v), continuing decline inferred in a number of mature individuals; B2, total area of occupancy less than 10 km^2; B2a, one population known; B2b(i–iii), habitat continuing decline inferred; D, population estimated to number fewer than 50 individuals. Threats to *P. kosraensis* include habitat degradation and destruction by pigs (*Sus scrofa* L.); predation of seeds by rats (*Rattus* Fischer); possible extinction as a result of natural catastrophes through environmental events (e.g., large fallen limbs that crush understory species, fires, flash floods, landslides); competition with invasive non-native plant taxa in the immediate area such as *Rubus moluccanus* L. and *Paspalum conjugatum* P. J. Bergius, in addition to ingress of the smothering vine *Merremia peltata* (L.) Merr. from lower elevations; and reduced reproductive vigor as the result of its limited population size.

Etymology. *Psychotria kosraensis* is named for the island of Kosrae where the type specimen was collected and the only known plants occur.

Discussion. Collections from Mt. Mutunte do not correspond with any previously described *Psychotria* species based on reviews of the Micronesian *Psychotria* by Fosberg and Sachet (1980a, 1980b, 1991) and comparison with specimens from other Pacific islands housed at BISH, PTBG, and US. Its caducous tubular-sheathing stipules that leave a ring of reddish brown colleters at stipule scars, as well as its floral and fruit morphologies, place it in subgenus *Psychotria* L. along with many other Polynesian and Micronesian congeners. For a more detailed discussion of *Psychotria* systematics, see Nepokroeff et al. (1999) and Lorence and Wagner (2005). This new species differs from other Micronesian members of the genus by its combination of narrowly obovate-elliptic to narrowly elliptic leaves with an acuminate apex, bifid stipule lobes, abaxially barbate leaf axils, pseudoaxillary fasciculate inflorescences, very short peduncles ca. 1 mm long, flowers with a long calyx tube with dentate lobes, and villosulous fruits crowned with the persistent well-developed calyx tube and lobes.

When following Fosberg and Sachet's (1991) key to the Micronesian *Psychotria* species, *P. kosraensis* keys most closely to *P. merrillii* Kaneh., a species endemic to the neighboring island of Pohnpei. Besides the previously mentioned distinctions, *P. kosraensis* differs conspicuously from *P. merrillii* by its narrowly obovate-elliptic to narrowly elliptic leaf blades with a long-acuminate apex, flowers on short pedicels ca. 1 mm, a much larger calyx tube 1.7–1.8 mm with lobes 1.2–1.8 mm, and larger corollas with the tube 5–6 mm and lobes 4.5–5 mm. *Psychotria merrillii*, in comparison, has broadly obovate-elliptic to occasionally broadly elliptic leaf blades with a bluntly short-acuminate apex, flowers on longer, more slender pedicels 7–10 mm, much smaller calyces with tubes 0.5–0.6 mm and minute lobes only 0.1 mm, and smaller corollas with the tube 1.5–3.5 mm and lobes 2.5–4.5 mm. Based on its vegetative morphology and short terminal inflorescences with strongly ascending pedicels, the new species resembles the poorly known *P. hosokawae* Fosberg, also endemic to Kosrae but known only from the immature flowering type collection (*Hosokawa 8775*, A). However, the latter species differs in having apparently calyptrate stipules and non-barbate leaf axils, an inflorescence composed of five once- or twice-branched cymes 2 cm, a very short scarcely lobed, ringlike calyx, and smaller corollas only ca. 3 mm in bud (Fosberg & Sachet, 1991). With the

inclusion of this new species, the *Psychotria* species in Kosrae can be separated using the modified key of Fosberg and Sachet (1991) as follows. Both *P. hombroniana* and *P. rhombocarpa* are distylous (Lorence, unpublished). However, the breeding system is uncertain for *P. kosraensis*, which is known only from a single (apparently long-styled) flowering collection and unknown in *P. hosokawae*, which is known only from a single collection with immature flowers.

Key to the Species of *Psychotria* in Kosrae

1a. Peduncles (primary inflorescence axis) up to 1 mm; calyx cylindrical, tube well-developed, 1.7–1.8 mm, and lobes 1.2–1.8 mm ..... *P. kosraensis*
1b. Peduncles (primary inflorescence axis) 10 mm or longer; calyx ringlike or cup-shaped, tube <1.7 mm, and lobes 0.1–0.5 mm.
  2a. Leaves <10(–14) × 3(–5) cm; inflorescences axillary filiform cymes, peduncles <0.5 mm diam. ..... *P. hombroniana*
  2b. Leaves >15 × 5 cm; inflorescences terminal branched cymes or panicles, peduncles 1.5–2 mm diam.
    3a. Leaves to 19 × 5 cm; inflorescences a cluster of 5 once- or twice-branched cymes 20 mm, short pedunculate with peduncles to 10 mm, flowers on strongly ascending pedicels to 5 mm .... *P. hosokawae*
    3b. Leaves to 25 × 9 cm; inflorescences a thyrsoid panicle with 4 to 5 pairs of secondary branches, long pedunculate with peduncles 40–70(–90) mm, flowers subsessile or pedicels 0.3–1 mm .... *P. rhombocarpa*

Paratype. FEDERATED STATES OF MICRONESIA. **Caroline Islands:** Kosrae, Lelu Municipality, Mt. Mutunte, NE slopes, *K. R. Wood, W. Law, C. Cianchini & J. Sanney 14778* (PTBG).

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A New Species of *Hymenoxys* (Asteraceae, Helenieae, Tetraneuridinae) from Texas

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ABSTRACT. *Hymenoxys perpygmaea* W. C. Holmes, Singhurst & Mink (Asteraceae, Helenieae, Tetraneuridinae) is described as a new annual species. The species, which is ephemeral, is endemic to an alfisol prairie that contains mima mounds in Lamar County from northeastern Texas, U.S.A. It is similar to *H. texana* (J. M. Coult. & Rose) Cockerell, but is easily distinguished from that species by its diminutive rosette and fewer florets per capitulum.

Key words: Asteraceae, Helenieae, *Hymenoxys*, IUCN Red List, Tetraneuridinae, Texas, U.S.A.

Hymenoxys Cass. is a New World genus of approximately 25 species, 17 of which occur north of Mexico (Bierner, 2006). Two of the 17 species are annual, with one, *H. texana* (J. M. Coult. & Rose) Cockerell, being endemic to Texas (Cockerell, 1904; Mahler, 1983; Bridges, 1988). This latter species is of conservation concern, being listed as endangered (G2S2) by the United States Fish and Wildlife Service (Poole et al., 2007). Recent field study of the tall grass prairies of Lamar County in northeastern Texas has resulted in the discovery of another annual species of *Hymenoxys*, which is described below.

Hymenoxys perpygmaea W. C. Holmes, Singhurst & Mink, sp. nov. TYPE: U.S.A. Texas: Lamar Co., Gambill Goose Prairie Refuge, 7.2 mi. W of Paris (+33.69617, −95.660550), 4 May 2009, *W. C. Holmes, J. R. Singhurst & J. N. Mink 14504* (holotype, BAYLU; isotype, MO). Figure 1.

Species nova *Hymenoxydis texanae* (J. M. Coult. & Rose) Cockerell similis, sed ab ea rosula 1.3–2.4 cm in diametro (vs. 4–7+ cm) et flosculis disci in quoque capitulo 17 ad 32 (vs. 45 ad 75+) differt.

Plants slender, erect, ephemeral, 5–6.9 cm tall; taproots slender, light brown, ca. 1.7 mm diam.; stems terete, glabrous, 0.3–0.7 mm diam., unbranched and leafless for the first 2–3 cm, divided distally into 1 or 2(4) head-bearing branches; rosettes 1.3–2.4 cm diam. Leaves 3 to 6, elliptic to obovate, 6–12 × 3–4 mm, margins entire, surfaces glabrous, glandular, midvein whitish, conspicuous in the proximal 1/2 of blade, apices rounded, rosettes turning yellow and withering prior to or at time of flowering, leaving an enlarged node 1–2 mm diam., often with 1–3 mm leaf remnants persisting, cauline leaves alternate, 4 to 8 per branch, linear, 6.4–10.5 × 0.5–2 mm, sessile, margins mostly entire, the midstem leaves occasionally irregularly toothed, surfaces glabrous, glandular, apices obtuse. Peduncles quadrangular, obscurely winged to ridged, surfaces sparsely crisp-puberulent, capitula terminal, 1 or 2(4), semi-campanulate, 4.3–7.9 × 3.1–5.4 mm; phyllaries in 2 series; outer 8, ovate-oblong, ca. 5 mm, glabrous, bases slightly connate, gibbous, margins entire, the distal 1/2 rather scabrous, apex acute; inner phyllaries 8, similar to outer, ca. 0.5 mm longer, apices rounded; receptacles hemispheric, ovoid, smooth, epaleate. Ray florets yellow, not exceeding phyllaries, ca. 7, pistillate, fertile, corollas ovate, ca. 2.8 mm, lobes (teeth) 3 or 4, rounded (ovate), ca. 0.4 mm. Disc florets yellow, bisexual, fertile, 17 to 32, glabrous, tube ca. 1.1 mm, throat cylindrical, ca. 1.4 mm, teeth deltate, ca. 0.2 mm; styles and style branches ca. 2.2 mm, undivided portion ca. 1.65 mm, style appendages ca. 0.55 mm; anthers ca. 0.8 mm, filaments ca. 0.3 m, appendages deltate. Cypselae obpyramidal, ca. 2 × 0.6 mm, densely velutinous; pappi possessing awned scales, the scales ovate, ca. 1 × 0.7 mm, margins entire,

Figure 1. Photograph of *Hymenoxys perpygmaea* W. C. Holmes, Singhurst & Mink taken at the type location (scale applies to both the larger and inset images). Habit and capitula of the holotype *Holmes, Singhurst & Mink 14504* (BAYLU). Photo by Darrell Vodopich, 4 May 2009. The inset image shows the basal leaves collected as the paratype *Singhurst 18134* (BAYLU). Photo by J. R. Singhurst, 25 February 2010.

awns ca. 1.5 mm, margins scabrid. Pollen spherical, ca. 33 μm, surfaces spinose.

Distribution and habitat. *Hymenoxys perpygmaea* is known to occur only in saline slick depressions on alfisols in the Gambill Goose Prairie Refuge, near Paris in Lamar County, Texas. This area, which is characterized by the presence of mima mounds, is located in the northeastern part of the Blackland Prairie vegetation region of Texas. For further descriptive analysis of the refuge habitat, see Mink et al. (2010).

IUCN Red List category. *Hymenoxys perpygmaea* is currently known from only one location and is considered (by the authors) to be Critically Endangered (CR B2a) (IUCN, 2001). The population is comprised of three subpopulations concentrated in discrete saline slick depressions. The area is estimated to be less than 0.1 km^2 and the total number of observed individuals less than 300. The refuge is owned and maintained by the city of Paris and is considered reasonably secure from major disturbance. It is maintained as recreational land with management practices mainly limited to periodic haying. However, potential hazards to the population are the use of all-terrain vehicles (ATVs) on the refuge and the rooting and wallowing of feral hogs (*Sus scrofa*).

Phenology. *Hymenoxys perpygmaea* was observed to flower April to May. The exact time of flowering during this period appears dependent on water availability based on seasonal precipitation.

Etymology. The species epithet *perpygmaea* alludes to the very diminutive nature of the plants as compared to other members of the genus. In anticipation of the new species being assigned a common name, we recommend that it be called pygmy prairie dawn.

Discussion. Morphologically, *Hymenoxys perpygmaea* appears nearest to *H. texana*, a species currently known from Harris and Ft. Bend counties (near Houston, ca. 500 km south of Lamar County) and Trinity County, which is approximately 280 km south of the type locale in Lamar County. *Hymenoxys texana* is well-marked by its larger and persistent basal rosette. Field studies have shown that *H. texana* rosettes begin appearing in late November and early December, attain a width of 4–7+ cm by the time of flowering (unpublished data), and persist until summer. The growth form is predominantly spreading, with one to 30 capitula, each with 40 to 75+ disc florets, produced per plant. Flowering may be initiated as early as mid- to late February and persists into the first part of April. Midstem leaves are most often lobed. *Hymenoxys perpygmaea* has a smaller rosette, not more than 2.4 cm diam., which appears in mid-February and is short-lived. Prior to or at the time of flowering, the rosettes turn yellow and begin withering away. The species appears to be ephemeral, apparently beginning growth in February and flowering April to May. Limited observations during 2009 and 2010 indicated that the exact time of flowering may be directly related to water availability. By mid- to late May, the plants have largely disappeared. This growth habit appears to be an adaptation for existence in the saline slicks, where by late May only desiccated remnant plants are available; lack of water (drought) is apparently a limiting factor. Each plant usually has one capitulum, but occasionally a plant may have two to four and each capitulum has 17 to 32 disc florets. Margins of leaves of the plant are entire, while the plants are strictly erect. That the species has only now been discovered seems related to its ephemeral nature, restricted distribution, and scarcity of appropriate habitats (i.e., saline slicks).

The Gambill Goose Prairie Refuge is classified as an alfisol *Sporobolus silveanus* (Swallen)–*Carex meadii* (Dewey) Herbaceous Prairie Association with mima mounds (NatureServe, 2010). The characteristic species of the slicks are ephemerals, short-lived annuals, or drought-tolerant specialists. Other than *Hymenoxys perpygmaea*, characteristic species are *Sporobolus pyramidatus* (Lam.) Hitchc., *Setaria parviflora* (Poir.) Kerguelén, *Aira elegans* Willd. ex Kunth (Poaceae), *Ptilimnium capillaceum* (Michx.) Raf. (Apiaceae), *Iva angustifolia* Nutt. ex DC., *Coreopsis basalis* (A. Dietr.) S. F. Blake, *Euthamia gymnospermoides* Greene, *Krigia occidentalis* Nutt. (Asteraceae), *Plantago hybrida* Bart. (Plantaginaceae), *Oenothera linifolia* Nutt. (Onagraceae), *Phemeranthus parviflorus* (Nutt.) Kiger (Portulacaceae), *Hedeoma hispida* Pursh, *Prunella vulgaris* L., *Pycnanthemum tenuifolium* Schrad. (Lamiaceae), *Fimbristylis puberula* (Michx.) Vahl (Cyperaceae), *Sabatia campestris* Nutt. (Gentianaceae), *Neptunia lutea* (Leavenw.) Benth. (Fabaceae), *Sisyrinchium angustifolium* Mill. (Iridaceae), *Nothoscordum bivalve* (L.) Britton, and *Allium drummondii* Regel (Liliaceae).

Singhurst 18134, a paratype cited below, is sterile and was collected for elucidating the structure of the basal leaves. As mentioned, basal leaves are never present during flowering.

Paratypes. U.S.A. **Texas:** Lamar Co., Gambill Goose Prairie Refuge of the city of Paris, 21 May 2009, *W. C. Holmes, R. S. Baldridge & J. N. Mink 14572* (BAYLU); same location, 25 Feb. 2010, *J. R. Singhurst 18134* (BAYLU).

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Impatiens ecornuta, a New Name for *Impatiens ecalcarata* (Balsaminaceae), a Jewelweed from the United States and Canada

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ABSTRACT. The new name *Impatiens ecornuta* Gerry Moore, Zika & Rushworth (Balsaminaceae) is proposed for the species of western North America currently recognized as *I. ecalcarata* Blank. The latter name is an illegitimate later homonym of *I. ecalcarata* Collett & Hemsl.

Key words: Balsaminaceae, *Impatiens*, North America.

In 1905, Joseph Blankinship described a new species of *Impatiens* L. (Balsaminaceae) from the Pacific Northwest using the name *I. ecalcarata* Blank. However, in 1890 Henry Collett and William Hemsley had previously described a new species of *Impatiens* from Burma using the name *I. ecalcarata* Collett & Hemsl. Thus, *I. ecalcarata* Blank. is an illegitimate later homonym that, barring formal conservation, must be replaced (McNeill et al., 2006, Art. 53.1). Formal conservation of the name *I. ecalcarata* Blank. does not seem warranted, since the range of this species is rather restricted and dissemination of a new name will not be difficult. It could be argued that the lack of current usage of the name *I. ecalcarata* Collett & Hemsl. (it is generally treated as a synonym) in Myanmar may warrant conservation of *I. ecalcarata* Blank. However, there is no guarantee that future revisions of *Impatiens* in Myanmar and adjacent areas would not lead to *I. ecalcarata* Collett & Hemsl. being held distinct. Thus, it seems best to leave *I. ecalcarata* Collett & Hemsl. available for use in pending revisions by not proposing *I. ecalcarata* Blank. for conservation over *I. ecalcarata* Collett & Hemsl. Therefore, the following name is provided as a replacement name for *I. ecalcarata* Blank.

Impatiens ecornuta Gerry Moore, Zika & Rushworth, nom. nov. Replaced name: *Impatiens ecalcarata* Blank., Sci. Stud. Montana Coll. Agric., Bot. 1: 84. 1905, nom. illeg., non *Impatiens ecalcarata* Collett & Hemsl., J. Linn. Soc., Bot. 28: 30, tab. 4. 1890. *Impatiens biflora* Walter var. *ecalcarata* M. E. Jones, Bull. Montana Univ., Biol. Ser. 15: 39. 1910. TYPE: U.S.A. Montana: Missoula Co. [now Sanders Co.], along a brook 1 m[ile] E of Plains, 9 Aug. 1901, *J. W. Blankinship s.n.* (holotype, MONT; isotypes, MONTU, WS, WTU).

Unlike the other native *Impatiens* species in the United States and Canada (e.g., *I. aurella* Rydb., *I. capensis* Meerb., *I. noli-tangere* L., *I. pallida* Nutt.), and as the specific epithet indicates (as well as Blankinship's specific epithet), the petaloid, lower saccate sepal in *I. ecornuta* is spurless. *Impatiens ecornuta* is known from wetlands in British Columbia, Idaho, Montana, Oregon, and Washington, at elevations below 1200 m. West of the Cascade Range in Oregon and Washington, *I. ecornuta* hybridizes with *I. capensis*, which has been introduced into this area (*I. capensis* is a native elsewhere in Canada and the United States; Ornduff, 1966, 1967; Zika, 2006b). The hybrid between *I. capensis* and *I. ecornuta* is known as *I.* ×*pacifica* Zika, and this hybrid may be genetically threatening the uncommon *I. ecornuta* (Zika, 2006a, 2006b).

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Nuevas Combinaciones en *Adiantopsis* (Pteridaceae, Cheilantheae) de América del Sur

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Resumen. Las especies del grupo *Cheilanthes dichotoma* Sw. (Pteridaceae, Cheilantheae) forman un grupo natural, reconocido por evidencias morfológicas, cercano al género *Adiantopsis* Fée. Los análisis moleculares basados en el gen del cloroplasto *rbcL*, también muestran la inclusión de estas especies en el clado de *Adiantopsis*. Dos nombres, *C. orbignyana* Kuhn y *C. recurvata* Baker, se transfieren a *Adiantopsis* como *A. orbignyana* (Kuhn) Ponce & Scataglini y *A. recurvata* (Baker) Ponce & Scataglini. El reconocimiento dentro de este género de otros dos nombres, *A. dichotoma* (Sw.) T. Moore y *A. tweediana* (Hook.) Pérez-Link & Hickey, también se apoya en este estudio.

Abstract. The species of the *Cheilanthes dichotoma* Sw. group (Pteridaceae, Cheilantheae) form a natural group that is morphologically close to the genus *Adiantopsis* Fée. Molecular analyses using the chloroplast *rbcL* gene further support the inclusion of these species in the *Adiantopsis* clade. Two names, *C. orbignyana* Kuhn and *C. recurvata* Baker, are transferred to *Adiantopsis* as *A. orbignyana* (Kuhn) Ponce & Scataglini and *A. recurvata* (Baker) Ponce & Scataglini. The other two names, *A. dichotoma* (Sw.) T. Moore and *A. tweediana* (Hook.) Pérez-Link & Hickey, are also supported and recognized within this genus.

Key words: *Adiantopsis*, Cheilantheae, *Cheilanthes*, Pteridaceae.

El grupo de *Cheilanthes dichotoma* Sw. (Pteridaceae, Cheilantheae) está formado por cuatro especies: *C. dichotoma* Sw., *C. orbignyana* Kuhn, *C. recurvata* Baker y *C. tweediana* Hook., que habitan en los territorios de Bolivia, Paraguay, sur de Brasil, Argentina y Uruguay, con una presencia excepcional en Ecuador (Ponce & Morbelli, 1989). Las especies de este grupo presentan rizomas suberectos o decumbentes, excepto rastreros en *C. tweediana*, con escamas subuladas o angostamente triangulares, bicoloras, castaño oscuras en el centro, márgenes claros; pecíolos castaños oscuros a negros, semiteretes, con o sin costillas concoloras; láminas herbáceas a cartáceas, con tricomas capitados, hialinos, blancuzcos o amarillentos, 2- a 4-celulares, 45–70 µm long., esparcidos en general en la cara abaxial; raquis surcado adaxialmente, con costillas concoloras o membranáceas; pínnulas o últimos segmentos peciolulados o subpeciolulados; pseudoindusios bien definidos, suborbiculados a lunulados, membranáceos o escariosos; esporas globosas o subglobosas, con perisporio crestado o reticulado-crestado.

Adiantopsis incluye alrededor de 20 especies y es muy afín a *Cheilanthes* Sw. Tryon y Tryon (1982) lo diferencian principalmente por sus esporas equinadas, mientras que en *Cheilanthes* las esporas presentan superficies ruguladas, crestadas o crestado-reticuladas, raramente verrugadas. Por sus esporas crestado-reticuladas, las especies del grupo *C. dichotoma* fueron consideras bajo este género.

El análisis de las esporas de *Cheilanthes* y *Adiantopsis* (Morbelli & Michelena, 1989; Morbelli & Ponce, 1997; Piñeiro et al., 2006) demuestra que la estructura interna del perisporio es similar en ambos géneros. La característica equinada de las esporas de *Adiantopsis* sería una variación superficial del patrón reticulado común en muchos cheilanthoides: el perisporio está compuesto por 1 a 3 capas de un retículo, formado por cordones fusionados, abierto a compacto o consolidado. Los cordones pueden proyectarse en superficie, formando crestas o equinas, o no se proyectan, generando una capa superficial continua, que puede ser granulada, rugulada o verrugada. Para *A. chlorophylla* (Sw.) Fée y *A. radiata* (L.) Fée, Piñeiro et al. (2006) describen el perisporio como equinado en superficie sobre una base de cordones o crestas fusionadas.

En la revisión del género *Adiantopsis* para la región caribeña, Barker y Hickey (2006) mencionan que *A. asplenioides* Maxon, la única especie con esporas crestado-reticuladas de esa región, es morfológicamente muy cercana al grupo *Cheilanthes dichotoma*, y que este complejo de especies de Sudamérica pertenecería a *Adiantopsis* o eventualmente constituiría otro género.

Adiantopsis y *Cheilanthes* pertenecen a la tribu Cheilantheae (Pteridaceae) y, como la mayoría de los

géneros cheilanthoides, presentan una convergencia morfológica asociada a la adaptación a ambientes áridos (Copeland, 1947; Tryon et al., 1990). Debido a estos fenómenos adaptativos los límites entre géneros o grupos de especies resultan difíciles de establecer. Frente a esta complejidad taxonómica se han aplicado técnicas de filogenia molecular para circunscribir grupos naturales dentro de las Pteridaceae. Gastony y Rollo (1995) comenzaron utilizando el gen del cloroplasto *rbcL*, y se continua hasta la actualidad con estudios filogenéticos en la familia y en los géneros cheilanthoides en particular, usando *rbcL* y otros genes (Kirkpatrick, 2007; Prado et al., 2007; Schuettpelz et al., 2007; Rothfels et al., 2008; Windham et al., 2009).

Ponce y Scataglini (2009; inédito) realizaron una filogenia de *Cheilanthes*, basada en *rbcL* y morfología, incluyendo más de 30 taxones cheilanthoides de América del Sur, entre los cuales se analizaron las especies *Cheilanthes dichotoma*, *C. orbignyana* y *C. tweediana*, junto a especies de *Adiantopsis* y de géneros afines como *Cassebeera* Kaulf., *Doryopteris* J. Sm., *Pellaea* Link y *Trachypteris* André ex Christ. Los resultados de este análisis mostraron a las tres especies del grupo *Cheilanthes dichotoma* incluidas dentro del clado de *Adiantopsis* con 82% de soporte. Con base en estos resultados, y en la evidencia morfológica, se asignan las especies del grupo *Cheilanthes dichotoma* al género *Adiantopsis*.

En consecuencia, el género *Adiantopsis* queda ahora definido por: rizomas suberectos o decumbentes, excepcionalmente rastreros, con escamas linear-lanceoladas o subuladas, bicoloras, más o menos esclerosadas en el centro y márgenes membranáceos; hojas fasciculadas, rara vez a lo largo del rizoma; pecíolos y raquis castaño oscuros a negros, lustrosos, semiteretes, a menudo surcados adaxialmente, con aristas laterales; láminas de contorno circular, ovado, triangular, pentagonal, pocas veces lineares, 2- a 4-pinnadas o pedadas, con diminutos pelos capitados, 2- a 3(4)-celulares, de cabezuela globosa amarillenta o blanquecina, menos común con pelos simples; últimos segmentos ovados, elípticos, triangulares o dimidiados, peciolulados o subpeciolulados, articulados o no; pseudoindusios reflexos, lobulados a lunulados, verdosos, membranáceos o escariosos; esporas reticulado-equinadas o reticulado-crestadas.

1. Adiantopsis dichotoma (Sw.) T. Moore, Index Fil. (T. Moore) 17. 1857. Basiónimo: *Cheilanthes dichotoma* Sw., Syn. Fil., 129, 335, tab. III, f. 7. 1806. *Pellaea dichotoma* (Sw.) Prantl, Bot. Jahrb. Syst. 3(5): 420. 1882. TIPO: Ecuador. "Regnum Quitense: Mte. St. Antonii," 1804, *L. Née s.n.* [expedición Malaspina] (holotipo, S no visto, foto en SI; isotipo, MA no visto, foto en SI). Figura 1A.

Cheilanthes flexuosissima Baker, Ann. Bot. (Oxford) 5: 212. 1891, syn. nov. TIPO: Brasil. Rio de Janeiro: Apr. 1875, *A. F. M. Glaziou 1482* (holotipo, K [barcode] 000633266; isotipo, P).

Distribución. *Adiantopsis dichotoma* se distribuye en Ecuador, Bolivia, Brasil (Paraná, Rio Grande do Sul), Paraguay (Alto Paraná, Concepción, Paraguarí), Argentina (Corrientes, Misiones) y Uruguay (Maldonado). Esta especie se encuentra en ambientes con vegetación chaqueña o pastizales arbustivos, sobre barrancas rocosas o suelos con pedregullo. Su hábito es apoyante o trepador, creciendo sobre otras hierbas, arbustos y a menudo entre Bromeliáceas.

Observaciones. *Adiantopsis dichotoma* se distingue fácilmente por su forma de vida escandente y láminas normalmente 4-pinnadas, raquis flexuosos y segmentos ovados o elípticos, lobulados.

Los especímenes tipo de *Cheilanthes flexuosissima* coinciden con la definición de *Adiantopsis dichotoma*, tanto en su morfología como en distribución geográfica, por lo tanto se incluye este nombre en la sinonimia de *A. dichotoma*.

Material examinado. ARGENTINA. **Corrientes:** Santo Tomé, Garruchos, *A. Krapovickas et al. 26083* (CTES, G). **Misiones:** Apóstoles, ruta prov. 94, 7 km de Garruchos, camino a Azara, Río Chimiray, 28°05′S, 55°42′W, *O. Morrone et al. 1105* (SI). BRASIL. **Paraná:** Mun. Guarapuava, Col. San Judas Tadeu, *G. Hatschbach 47323* (G, MBM, US). **Rio Grande do Sul:** Santa Cruz, Col. Guarany, 1906, *Jurgens 259* (P). ECUADOR. Baños, 3 Oct. 1921, *Herborn s.n.* (SI). PARAGUAY. **Alto Paraná:** Colonia Mayntzhusen, *K. Fiebrig 5903* (G, K, SI). **Concepción:** Rio Apa und Rio Aquidaban, *K. Fiebrig 4194* (G, K, P). **Itapua:** Encarnación, *Hassler & Rojas 1443* (P), *E. Hassler s.n.* (SI). **Paraguarí:** prope Sapucay, *Hassler 11122* (G). URUGUAY. **Maldonado:** Piriápolis, *A. Lombardo 2670* (G).

2. Adiantopsis orbignyana (Kuhn) Ponce & Scataglini, comb. nov. Basiónimo: *Cheilanthes orbignyana* Kuhn, Linnaea 36: 82. 1869. TIPO: Bolivia. "La Laguna" [ahora Padilla], *A. D'Orbigny 388* (holotipo, B-20 0038000, Image-Id: 224564; isotipos, P, foto en US, G). Figura 1B, C.

Distribución. *Adiantopsis orbignyana* se encuentra en Perú (Cajamarca), Bolivia (La Paz), Paraguay (Alto Paraguay) y Argentina (Salta). Este helecho, poco frecuente, crece en el bosque nublado, en bosques semi-deciduos y también en muros de piedras antiguos.

Figura 1. —A. *Adiantopsis dichotoma* (Sw.) T. Moore, pinna (*Mutinelli 14*, SI). —B, C. *Adiantopsis orbignyana* (Kuhn) Ponce & Scataglini, porción de la fronde, vista adaxial y detalle vista abaxial (*Fortunato et al. 3733*, SI). —D. *Adiantopsis recurvata* (Baker) Ponce & Scataglini, pinnas en vista abaxial (*Rojas 3006*, SI). —E. *Adiantopsis tweediana* (Hook.) Pérez-Link & Hickey, pinnas en vista abaxial (*Burkart 6818*, SI).

Observaciones. *Adiantopsis orbignyana* se diferencia por sus pínnulas pinnatífidas, ovado-triangulares o triangulares, remotas, con segmentos oblongos o triangulares, lobulados, normalmente expandidos, mientras que en las especies cercanas *Cheilanthes dichotoma* y *C. recurvata*, las pínnulas y últimos segmentos son ovados o suborbiculares, contraídos. *Adiantopsis orbignyana* también se puede confundir

con *A. chlorophylla*, pero en esta especie los últimos segmentos son elípticos o triangulares, a menudo inequilaterales, y las esporas son equinadas.

Material examinado. ARGENTINA. **Salta:** Dpto. Capital, Cerro Túnel, frente a Vaqueros, *L. Novara 4979* (MCNS). BOLIVIA. **La Paz:** Inquisivi, Huañahawira, 3 km NW of Quimé, 17°02′S, 67°15′W, cloud forest above Río Khatu, *L. J. Dorr et al. 6766* (US). PARAGUAY. **Alto Paraguay:** Cerro Cabrera, 19°38′S, 61°42′W, *R. Fortunato et al. 3733* (SI). PERU. **Cajamarca:** Contumaza, La Pampa, Guzmango, *A. Sagástegui & R. Samamei 2937* (F, GH, US).

3. Adiantopsis recurvata (Baker) Ponce & Scataglini, comb. nov. Basiónimo: *Cheilanthes recurvata* Baker, J. Bot. 16(n.s. 7): 299–300. 1878. TIPO: Paraguay. Asunción, Co. Lambaré, "Pontes rocailleuses du Cerro–Lambaré," 1 Nov. 1876, *B. Balansa 358* (holotipo, K [barcode] 000633276; isotipos, BM, G, P). Figura 1D.

Distribución. *Adiantopsis recurvata* se distribuye casi exclusivamente en Paraguay (Chaco, Guairá, Paraguari), siendo muy rara en Argentina (Misiones), de donde existe una colección muy antigua del área con cerrado en esta provincia (Santa Ana y San Ignacio). Su hábito es cespitoso, creciendo en vegetación de chaco y cerrado o en montes ribereños, entre rocas o piedras.

Observaciones. En la revisión de las especies del grupo *Cheilanthes dichotoma* (Ponce & Morbelli, 1989) se incluyó a *C. recurvata* en la sinonimia de *C. orbignyana*. Un análisis más amplio de este grupo permitió encontrar diferencias entre ambas especies. *Cheilanthes recurvata* se distingue de *C. orbignyana* por las escamas rizomáticas que presentan el margen hialino mucho más amplio y por los últimos segmentos suborbiculares muy contraídos.

Aunque la especie no ha sido muestreada para los estudios moleculares, se la trata bajo este género por sus similitudes morfológicas con el resto de las especies del grupo: crecimiento cespitoso, escamas rizomáticas bicoloras, pecíolos y ejes atropurpúreos, semiteretes, raquis con cortas aristas membranáceas, láminas herbáceas a cartáceas, últimos segmentos peciolulados, presencia de pelos glandulares 2-celulares, de cabezuela blancuzca o amarillenta, esporas crestado-reticuladas.

Material examinado. ARGENTINA. **Misiones:** Santa Ana, 26 Nov. 1896, *N. Alboff s.n.* (SI). PARAGUAY. **Alto Paraguay:** Cerro Galván, Puerto Casado, *T. Rojas 1829* (SI). **Guairá:** Cordillera de Ybytyruzú, rd. to Polilla, *Zardini & Velazquez 13575* (CTES). **Paraguari:** Cerro Acahay, *T. Rojas 3006* (P, SI, US).

4. Adiantopsis tweediana (Hook.) Link-Pérez & Hickey, Taxon 60: 1266. 2011. Basiónimo: *Cheilanthes tweediana* Hook., Sp. Fil. 2: 84, tab. 96B. 1852. TIPO: Brasil. "S. Brazil, banks of the river Paraná," s.d., *J. Tweedie s.n.* (holotipo, K [barcode] 000633277; isotipo, US-01470293 [K fragm.]). Figura 1E.

Distribución. *Adiantopsis tweediana* se distribuye en Bolivia (Cochabamba, Santa Cruz), Brasil (Mato Grosso), Paraguay (Caaguazú, Cordillera) y Argentina (Chaco, Córdoba, Corrientes, Formosa, Santa Fé). A esta especie se la encuentra tanto en los valles secos interandinos y matorrales xerofíticos (chaqueños), como en bosques en galería o en planicies con suelos arcillosos erosionados.

Observaciones. *Adiantopsis tweediana* se incluye en el grupo *Cheilanthes dichotoma*, por sus pecíolos castaño oscuros con escamas bicoloras, láminas 2-pinnadas, raquis acanalados con aristas laterales, últimos segmentos peciolulados, herbáceos, lobulados; pseudoindusios lobulados, membranáceos. Se diferencia del resto de las especies del grupo por sus rizomas rastreros, horizontales y sus hojas de contorno lineal, remotas o subremotas. En el análisis filogenético (Ponce & Scataglini, inédito) se encuentra como especie hermana de *C. dichotoma*, los mismos resultados obtuvieron Link-Pérez et al. (2011) en su redefinición del género *Adiantopsis*.

Material examinado. ARGENTINA. **Chaco:** Colonia Benítez, *Schultz 30/2218* (US). **Córdoba:** San Javier, La Viña, *H. H. Bartlett 20618* (SI, US). **Corrientes:** Dpto. Lavalle, Cañada de los Perros, ruta 27, al S de Santa Lucía, *A. Schinini 5149* (CTES, F). **Formosa:** Pilcomayo, Isla Leona, *I. Morel 7686* (G). **Santa Fé:** Lanteri, Est. Bonazzola, *M. M. Job 1245* (GH). BOLIVIA. **Cochabamba:** Cercado, Cochabamba, Cerro San Pedro, 17°22′32″S, 66°08′06″W, *N. Ritter 2752* (LPB). **Santa Cruz:** Andrés Ibáñez, 12 km E of Santa Cruz on rd. to Cotoca, 17°46′S, 63°04′W, *M. Nee 36295* (G, NY, P, SI). BRASIL. **Mato Grosso:** 20 km E Porto Murtinho, no chao, *J. M. Pires & P. P. Furtado 17294* (CTES, NY). PARAGUAY. **Caaguazú:** Arroyo Yakare'í, along S side from rte. 2, *E. Zardini & Velázquez 10747* (G). **Cordillera:** San Bernardino, *E. Hassler 208* (SI).

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A New Combination in *Phemeranthus* (Montiaceae) and Notes on the Circumscription of *Phemeranthus* and *Talinum* (Talinaceae) from the Southwestern United States and Northern Mexico

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Abstract. The name *Talinum parvulum* Rose & Standl. is transferred to *Phemeranthus* Raf. (Montiaceae) as *P. parvulus* (Rose & Standl.) D. J. Ferguson & T. M. Price. Described in 1911 from Durango, Mexico, this species closely resembles *P. marginatus* (Greene) Kiger [≡ *T. marginatum* Greene], which was described in 1912 from Nayarit. *Phemeranthus marginatus* is here treated as a taxonomic synonym of *P. parvulus*.

Key words: Mexico, Montiaceae, North America, *Phemeranthus*, Portulacaceae, *Talinum*.

Recently, the genus *Phemeranthus* Raf. has been resurrected to accommodate the predominantly North American terete-leaved species of *Talinum* Adans. (Portulacaceae s.l.) (Hershkovitz & Zimmer, 1997; Kiger, 2001; Ocampo, 2002, 2003). Molecular and morphological evidence demonstrates that *Phemeranthus* is distinct from and only distantly related to *Talinum* s. str. (Carolin, 1987; Hershkovitz, 1993; Hershkovitz & Zimmer, 1997, 2000; Applequist & Wallace, 2001; Nyffeler & Eggli, 2010). Multiple well-supported clades have been recognized at the family level within the traditional Portulacaceae. Based on phylogenetic analyses of nuclear (ITS) and chloroplast (*ndhF*, *matK*) sequences, *Talinum* s. str. and its close relatives are more closely related to *Portulaca* L. and the Cactaceae than to *Phemeranthus*. Exemplars from the latter genus resolve within a clade of predominantly western North American taxa (Hershkovitz & Zimmer, 1997, 2000; Applequist & Wallace, 2001; Applequist et al., 2006) that has been elevated to family level as the Montiaceae (Angiosperm Phylogeny Group, 2009; Nyffeler & Eggli, 2010). *Talinum*, *Talinella* Baill., and the monotypic taxon *Amphipetalum* Bacigalupo constitute the small but heterogeneous family Talinaceae (Nyffeler & Eggli, 2010). Under this recent reclassification, Portulacaceae s. str. now comprises only the single genus *Portulaca* (Angiosperm Phylogeny Group, 2009; Nyffeler & Eggli, 2010).

Most terete-leaved *Talinum* species distributed in the United States have been previously transferred to *Phemeranthus* (Hershkovitz & Zimmer, 1997; Kiger, 2001) and were treated as such in the *Flora of North America* (Kiger, 2003a). Four Mexican species were also previously transferred (Ocampo, 2002, 2003). The combination *P. punae* (R. E. Fr.) Eggli & Nyffeler has been published recently for a disjunct species in northern Argentina (Nyffeler & Eggli, 2010). Originally described as *Calandrinia punae* R. E. Fr., this species was previously treated as *T. punae* (R. E. Fr.) Carolin; *Calandrinia* Kunth is also now placed within the Montiaceae. Herein, we further propose the transfer of *T. parvulum* Rose & Standl. to *Phemeranthus*. Described in 1911 from Durango, Mexico, this species closely resembles *P. marginatus* (Greene) Kiger, which was described in 1912 from material collected in 1897 in Nayarit, Mexico. We treat the latter as a taxonomic synonym of the former.

Phemeranthus parvulus (Rose & Standl.) D. J. Ferguson & T. M. Price, comb. nov. Basionym: *Talinum parvulum* Rose & Standl., Contr. U.S. Natl. Herb. 13: 283. 1911. TYPE: Mexico. Durango: Otinapa, 25 July–5 Aug. 1906, *E. Palmer 451* (holotype, US-571476; isotypes, GH not seen, K [barcode] 424706 image, NY [barcode] 342320).

≡ *Talinum marginatum* Greene, syn. nov. Leafl. Bot. Observ. Crit. 2: 270. 1912. *Phemeranthus marginatus* (Greene) Kiger, Novon 11(3): 320. 2001. TYPE: Mexico. Nayarit: Sierra Madre near Santa Teresa, Tepic, 12 Aug. 1897, *J. N. Rose 2221* (holotype, US-301135).

Discussion. *Phemeranthus parvulus* (bottle-leaf fameflower) is distinguished by its tiny size (up to 5 cm tall, and often only 2–3 cm tall) and apparently petiolate leaves, which are strongly narrowed toward the base. These characteristics similarly distinguish *P. marginatus*. The type specimens of *Talinum parvulum* and *T. marginatum* at US appear to differ

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mainly in size. *Talinum parvulum* is extremely small, with slender leaves whose narrowed petiole-like portion is as long as or longer than the expanded distal portion, and with minute seeds (about 0.5 mm wide). *Talinum marginatum* appears to be larger, with plants to 5 cm high; has thicker leaves whose narrowed petiole-like portion is equal to or shorter than the expanded, oblanceolate-spatulate distal portion; and has broader seeds (nearly 1 mm in diam.).

The name *Talinum marginatum* has been usually applied to specimens from Arizona, Sonora, and Chihuahua. The southern part of the range (e.g., Nayarit, where the type specimen for *T. marginatum* was collected) is poorly represented in herbaria. Application of the name *T. parvulum* has apparently been limited to specimens collected from Durango, where the type specimen was collected. Wilson (1932), Von Poellnitz (1934), and Eggli (2002) treated these as separate species, but their judgments were probably impacted by the small number of available specimens. In his 1912 description of *T. marginatum*, Greene did not mention *T. parvulum*, but rather compared his species to *T. humile* Greene (sic, as *humili*) and *T. greenmanii* Harshb. (sic, as *Greenmanianum*), stating that the new species differed from the latter two in having flat, scarious-margined leaves rather than linear, terete leaves. This observation was clearly based on herbarium material rather than on living plants; such scarious margins occasionally appear as artifacts of the drying process in probably all *Phemeranthus* species.

Available specimens show a more or less continuous range of variation from the very small typical *Phemeranthus parvulus* to the much larger *P. marginatus*, and plants at a given locality can vary between the two extremes from year to year depending on environmental conditions (Ferguson, pers. obs.). Although further study is needed, there appear to be no distinctive characters to separate the two entities, and we conclude that they are conspecific. Thus, *Talinum marginatum* is synonymous to *T. parvulum*. *Phemeranthus parvulus* should be applied to the merged taxon, which is widespread in the Sierra Madre Occidental from southern Arizona south to Nayarit.

Phemeranthus multiflorus (Rose & Standl.) G. Ocampo also closely resembles *P. parvulus*, differing in its non-petiolate leaves (although this character may be difficult to distinguish in herbarium material due to shrinkage in drying) and its larger inflorescences, which usually well exceed the leaves and tend to sprawl. The inflorescences of *P. parvulus* also often exceed the leaves, but at least the lowermost flowers and capsules are borne among the leaves, and the inflorescences appear more erect and congested. The names *Talinum parvulum* and *T. multiflorum* Rose & Standl. were published concurrently in 1911 by Rose and Standley, who distinguished the former species by its small size (2.5 cm or less), petiolate leaves, and inflorescences not exceeding the leaves; and the latter species by its larger size (up to 10 cm), non-petiolate leaves, and spreading, highly branched inflorescences much surpassing the leaves. Further investigation may indicate that *P. parvulus*, *P. marginatus*, and *P. multiflorus* all form a single variable species.

Specimens examined. MEXICO. **Chihuahua:** 3.3 mi. S of Chorro de Agua on rd. to sawmill El Cuervo, *T. R. Van Devender 87-117* (ARIZ-271668); Cascada de Basaseachic, *M. Fishbein 1790* (ARIZ-315550). **Durango:** Otinapa, *E. Palmer 451* (NY [barcode 342320], US-571476); along dirt rd. betw. Hidalgo del Parral & El Vergel, ca. 58 mi. W of Parral & 23.1 mi. W of Ojito, *J. L. Reveal 3091* (MO-3038554). **Nayarit:** Sierra Madre near Santa Teresa, Tepic, *J. N. Rose 2221* (US-301135). **Sonora:** 3.4 km N of Yecora on rd. to Agua Blanca, *A. L. Reina 97-766* (TEX-258804). U.S.A. **Arizona:** Cochise Co., Huachuca Mtns., Mud Spring fork of Sycamore Canyon, *M. Fishbein 1317* (ARIZ-306552); Santa Cruz Co., 5 mi. S of Sonoita, *J. Kaiser 1545* (ARIZ-270807).

Notes on the Circumscription of *Phemeranthus* and *Talinum*

Kiger (2001) transferred *Talinum aurantiacum* Engelm. to *Phemeranthus*, treating *T. angustissimum* (Engelm.) Wooton & Standl. and *T. whitei* I. M. Johnst. as its synonyms in 2003. However, Applequist and Wallace (2001) included samples of *T. angustissimum* and *P. mengesii* (W. Wolf) Kiger in a phylogenetic analysis of chloroplast *ndhF* sequences from the Portulacaceae s.l. Their data supported *P. mengesii* as sister to a clade of predominantly western North American taxa that included exemplars from *Calandrinia*, *Calyptridium* Nutt., *Cistanthe* Spach, *Claytonia* L., *Lewisia* Pursh, *Montia* L., and *Montiopsis* Kuntze (all of which are now placed in the segregate family Montiaceae). However, the sampled accession of *T. angustissimum* fell within a clade of other *Talinum* and *Talinella* species. Thus, the *ndhF* evidence strongly contradicted the inclusion of *T. angustissimum* in *Phemeranthus*. Similar results were obtained in a later study using an expanded version of the same data set (Applequist et al., 2006). Additional molecular data from several chloroplast loci for multiple accessions of *P. aurantiacus* (Engelm.) Kiger sensu Kiger, 2003a (Price, unpublished) strongly indicate that this taxon falls within the *Talinum* clade and is only distantly related to *Phemeranthus*. Moreover, Eggli (2002)

treated *T. angustissimum*, *T. aurantiacum*, and *T. whitei* all as synonyms of *T. polygaloides* Gillies ex Arn., which was described from Argentina. In a molecular phylogenetic study of the relationships among the Cactaceae and its closest relatives, Nyffeler (2007) sampled a *T. polygaloides* exemplar from Argentina, which was strongly supported as sister to *T. caffrum* Eckl. & Zeyh. within the *Talinum* clade.

Morphologically, *Phemeranthus aurantiacus* exhibits several characteristics that are inconsistent with the genus. The leaves, while narrowly linear, are planar rather than terete to sub-terete in shape and have distinct midveins. The flowers are yellow, orange, or reddish orange; other *Phemeranthus* species possess purplish or rosy-pink, white, or yellow (but not orange) flowers. The inflorescences consist of solitary flowers or 2- or 3-flowered cymules in leaf axils, rather than many-flowered cymes borne on lateral or terminal, scapelike peduncles. Although the seeds have distinct concentric ridges rather than a minutely tuberculate surface like those of most other *Talinum* (Kiger, 2003b), they lack the investing aril or pellicle (a thin, papery covering) present in other *Phemeranthus* seeds. Thus, based on the combination of molecular and morphological evidence, *T. aurantiacum* should clearly be retained in *Talinum*.

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Gentianella weigendii (Gentianaceae), an Unusual New Gentian from Peru

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Abstract. *Gentianella weigendii* J. S. Pringle is described as a new species from Peru. It is distinctive among the South American species of *Gentianella* Moench (Gentianaceae) in its combination of green corollas scarcely longer than the calyces, stamens inserted at different levels on the corolla tube, and raised nectaries.

Resumen. Se describe *Gentianella weigendii* J. S. Pringle, una nueva especie del Perú. Es distintiva entre las especies de *Gentianella* Moench (Gentianaceae) de América del Sur por la combinación de las corolas verdes poco más largas que los cálices, los estambres insertos a nivales diversos en el tubo de la corola, y los nectarios sobresalientes.

Key words: Gentianaceae, *Gentianella*, IUCN Red List, Peru.

Gentianella Moench, formerly usually included in *Gentiana* L., comprises ca. 300 species, of which ca. 200 are endemic to the high mountains of South America. This genus attains its greatest diversity in Peru, where ca. 90 species are native. New species of *Gentianella* continue to be discovered in South America, one of which is described here.

Gentianella weigendii J. S. Pringle, sp. nov. TYPE: Peru. Ancash: Sihuas, rd. from Sihuas to Yanac before Pomabamba turnoff, 10 Mar. 2001, *M. Weigend, K. Weigend, M. Binder & E. Rodríguez 5083* (holotype, HUT digital image; isotypes, HAM, M digital image). Figure 1.

Haec species inter congeneros austroamericanos corollis viridibus calycibus vix longioribus, staminibus inaequalibus et nectariis prominentibus distinguenda.

Herb, glabrous throughout; plants probably monocarpic, remaining in vegetative stage for a lengthy period before flowering; primary stem single; oldest portion covered with bases of old leaves; flowering stem erect, hollow, stout, 3–6 dm, 10–20 (proximally) to 4–6 (distally) mm diam.; strongly ascending floriferous branches arising from all axils above basal rosette, proximal and mid-cauline branches to 11 cm on larger plants, distal branches shorter, peduncle-like. Leaves basal and cauline; basal leaves present during flowering and fruiting (16 to 40 green basal leaves on specimens seen, many more in various stages of disintegration); basal leaves linear, 7–12 cm × 4–13 mm, acute to acuminate but with extreme tip obtuse; cauline leaves in whorls of 4, widely spaced (mid-cauline internodes mostly 4–10 cm), proximal cauline leaves similar to basal leaves, distal leaves gradually more lanceolate, shorter, and more strongly acuminate, mid-cauline leaves mostly 2.5–7 cm × 7–13 mm; bases not connate-sheathing, margins smooth. Inflorescence an elongate thyrse of leafy-bracted cymules on distal parts of primary stem and branches; flowers erect; pedicels in terminal cluster 5–15 mm or 1 to 3 central pedicels to 25 mm, elevating central flowers above lateral ones; flowers 6 to 15 in terminal clusters, fewer and with shorter pedicels in clusters in distal axils and on branches; total flowers per stem 60 to 250 or more; flowers on proximal branches sometimes ± reduced. Flowers pentamerous; calyx 8.5–14 mm, lobed 0.45–0.65× its length; lobes erect, narrowly triangular, acute, unequal in quincunxial pattern with outermost longest and widest, overlapping margins narrowly decurrent on tube; intracalycine colleters absent; corolla green, nearly cylindric, 9–16 mm, 1–1.25× as long as calyx, lobed 0.35–0.45× its length; lobes equal, widely ovate-triangular, 3.5–5.5 × 3–4.5 mm, ca. 1.25× as long as wide, obtuse, conspicuously overlapping adjacent lobes where widest; corolla trichomes absent; nectaries 5, on corolla tube near base, probably purple when fresh, sharply defined and raised above adaxial corolla surface, oblong, ca. 1.2 mm, shallowly emarginate; stamens with all anthers presented approximately at same level but with filaments inserted at different levels on corolla tube, filaments 1.5–3 mm within a single flower, inserted at 0.8–0.9× height of tube; anthers dark blue, ca. 1.7 mm; ovary compressed-cylindric, stipe ca. 1 mm at anthesis; stigmas narrowly elliptic-spatulate, ca. 1.4 × 0.6 mm. Capsule not winged; stipe scarcely elongating, little or no more than stigmatic lobes of mature capsule exserted from marcescent corolla; seeds brown, irregularly ellipsoid, ca. 0.9 × 0.7 mm; seed coat obscurely reticulate.

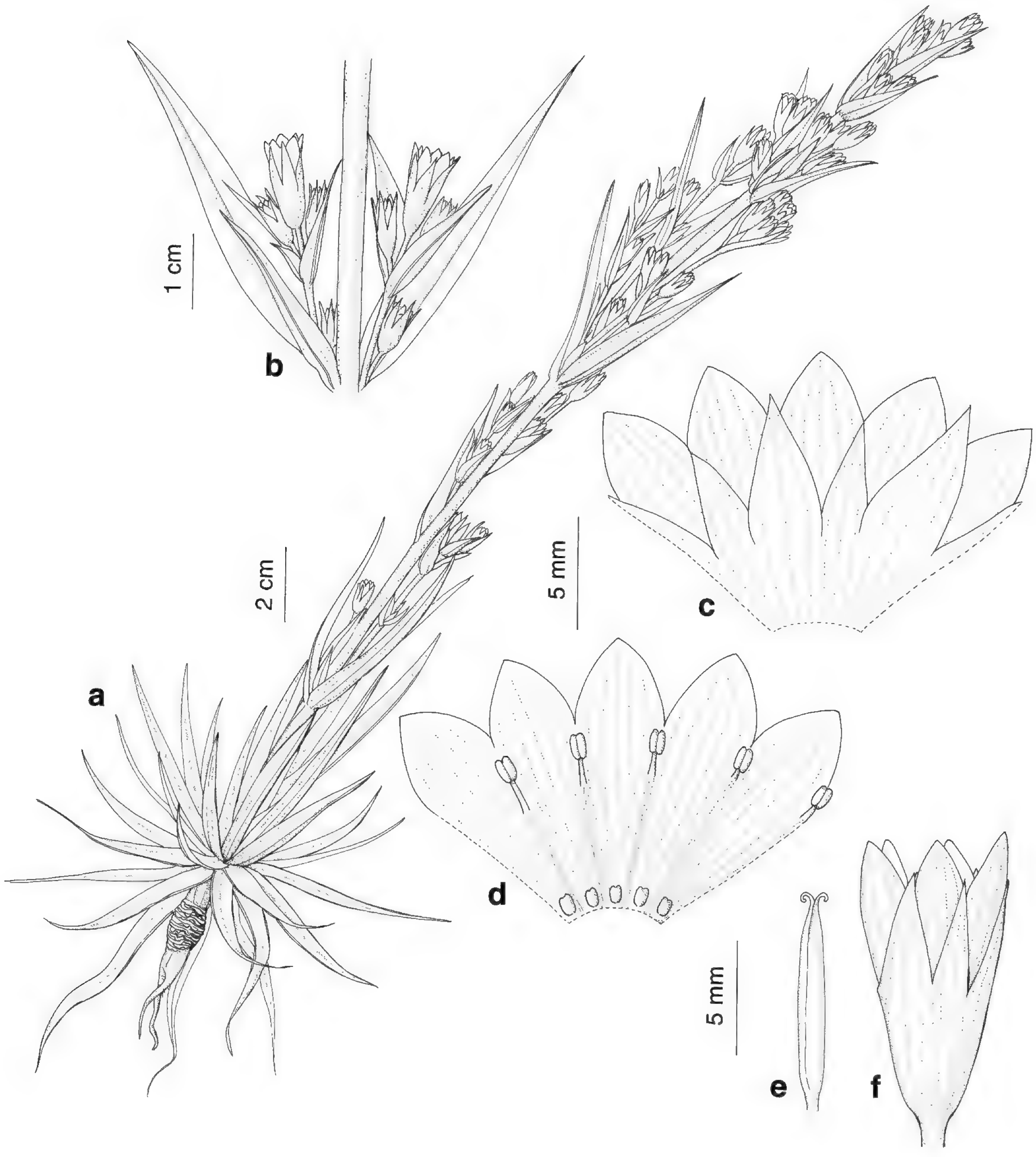

Figure 1. —A. Fertile plant. —B. Mid-cauline node with axillary flowering branches. —C. Perianth, abaxial view. —D. Corolla, adaxial view, with stamens and nectaries. —E. Pistil. —F. Intact flower. Drawn from type images, *Weigend et al. 5083* (HAM, HUT, M).

Habitat and phenology. *Gentianella weigendii* is known only from the type collection. It was found in well-developed jalca vegetation, among numerous shrubs and perennial herbs, at 4000 m (*Weigend et al. 5083*, in sched.). The March date of this collection provides the only information available on its phenology.

IUCN Red List category. Data are deficient for recommended listing (DD) (IUCN, 2001). With the species being known only from a single locality in northern Ancash Department, it seems likely that its total geographic range is not extensive, although according to Maximilian Weigend (pers. comm., 23 June 2009), *Gentianella weigendii* was locally common at the type locality.

Etymology. *Gentianella weigendii* is named for Maximilian Weigend, of the Institut für Biologie–Systematische Botanik und Pflanzengeographie–der Freien Universität der Berlin, who collected the type specimen and thought that it represented a new

species. The name recognizes Dr. Weigend's extensive botanical exploration in Peru and his description of many new species.

Discussion. According to Weigend (pers. comm., 2009), *Gentianella weigendii* was highly homogeneous at the type locality. That the corollas were green when fresh was stated by the collectors (in sched.) and observed in a digital image provided by Weigend for this study. Observations of flowers in various stages in the type collection, as well as fruits surrounded by marcescent corollas, confirm that the corollas of this species remain small and green.

As observed in the image of fresh matertial noted above, the leaves, calyces, and corollas of *Gentianella weigendii* are bright medium green when fresh, contrasting with the pale yellowish green of the stout stem. In both fresh material and herbarium specimens collected in flower, the corolla color does not differ appreciably from that of the leaves and calyces, except for a narrow paler zone proximally along the margins of the corolla lobes. Otherwise, in South American *Gentianella*, green corollas similar in color to the leaves and calyces occur only in *G. chlorantha* J. S. Pringle, a highly dissimilar Peruvian species with numerous, closely spaced leaves only 6–8 mm, and in *G. thyrsoidea* (Hook.) Fabris, with which *G. weigendii* is contrasted below.

Corollas largely concealed by the calyces occur only in *Gentianella weigendii* and *G. thyrsoidea* in South American *Gentianella*; in all other species the corollas are proportionately longer and more conspicuous. The widely ovate-triangular corolla lobes of these two species are also unusual in South American *Gentianella*. This corolla-lobe shape, with the lobes shorter than the tube, is approached in the Ecuadorian *G. jamesonii* (Hook.) Fabris, which has red corollas much exceeding the calyx, but in most of the species native from Peru north to Colombia the corolla lobes are elliptic to obovate, widest near or distal to the middle. Ovate corolla lobes occur in several species in Argentina and Bolivia, but all of those species differ distinctly from *G. weigendii* in vegetative characters and inflorescence form as well as in their showier corollas.

Nectaries sharply defined and distinctly raised above the adaxial corolla surface are known in *Gentianella* only in *G. weigendii* and *G. florida* (Griseb.) Holub, having been reported in the latter species by Filippa and Barboza (2006) and subsequently seen in this study (*Nee 40342*, HAM). The nectaries of *G. florida* are less prominently raised than those of *G. weigendii*. *Gentianella florida*, which is native to Argentina and Bolivia, is one of a group of florally heteromorphic species with showy, corymbiform cymes and white, yellow, or lilac corollas. None of the species in that group is similar to *G. weigendii*. In all other species, as far as is known, the nectaries, if any, are patches of small cells on the corolla tube below each lobe, usually U- or V-shaped, not raised above the adaxial surface of the tube.

Androecial zygomorphy, with the filaments inserted at different levels on the corolla tube and differing in length, has not previously been reported in *Gentianella*. In the flower from which Figure 1 was drawn, the corolla of which was 14 mm with the tube 9 mm, one filament was 2.5 mm from its insertion to the point of attachment to the anther, those of the stamens on each side were 2 mm, and those of the other two stamens were 1.5 mm. In another corolla, which was 15 mm, the filaments ranged from 1.5–3 mm. The shorter filaments are inserted higher on the corolla tube, elevating all five anthers to approximately the same level. All of the stamens are inserted in the distal fifth of the corolla tube but distinctly below the sinuses.

In habit, *Gentianella weigendii* has much in common with *G. weberbaueri* (Gilg) Fabris, which is likewise native to Ancash Department and to which it may be closely related. Both species have a single stout, hollow primary stem, with numerous strongly ascending branches at nodes from near the base to the summit; persistent basal leaves, more than 50 flowers per stem, in an elongate thyrse; narrowly triangular calyx lobes about as long as the tube; and corolla lobes distinctly shorter than the tube. Both lack calycine colleters and corolline trichomes. The flowers of *G. weberbaueri*, unlike those of *G. weigendii*, are showy, exserted well beyond the subtending bracts on pedicels 1.5–7 cm, and are more or less nodding. The corollas are purplish red, 20–50 mm, with spatulate-elliptic lobes 0.25–0.4× as long as the tube. The filaments of *G. weberbaueri* are 10–20 mm, all inserted at the same level about 0.5× the height of the corolla tube. The nectaries are neither conspicuous nor raised.

Gentianella weigendii shares several morphological traits uncommon in *Gentianella* with *G. thyrsoidea*, and may be closely related to that species as well as to *G. weberbaueri*. *Gentianella thyrsoidea* is a relatively widespread species in Peru, known from central Ancash Department but not seen by Weigend et al. where they found *G. weigendii* in northern Ancash. In both *G. weigendii* and *G. thyrsoidea*, the stem is solitary, stout, and hollow; basal leaves are present at flowering time; the cauline leaves are whorled; the inflorescence is a leafy-bracted, many-flowered thyrse with strongly ascending branches; the flowers are erect on short pedicels; the calyx lobes are narrowly triangular; adaxial calycine colleters and

corolline trichomes are absent; the corollas are green and scarcely longer than the calyces; and the corolla lobes are ovate-triangular, shorter than the tube. The flowers of *G. weigendii* and *G. thyrsoidea* are similar in aspect, but in *G. thyrsoidea* the filaments are equal, 5–8 mm, all inserted at the same level about 0.5× the height of the corolla tube. At 10–60× magnification I detected no floral glands in *G. thyrsoidea* (*Weigend et al. 5125* and *7712*, HAM), but observations with fresh material and with SEM would be desirable.

Vegetatively, *Gentianella weigendii* and *G. thyrsoidea* differ distinctly. Plants of *G. thyrsoidea* are 0.2–3.5 dm; those of *G. weigendii* are 3–6 dm. In *G. thrysoidea* the basal and near-basal leaves are very numerous, often over 100, and the cauline leaves are closely spaced the entire length of the stem (distal internodes commonly 2–8 mm, occasionally to 15 mm, rarely to 40 mm on the tallest plants). The leaves are ascending and distally incurved, and in combination with the closely spaced axillary cymules, often conceal much of the stem. All of the leaves are narrowly linear, mostly 1–7 cm × 1–3 mm exclusive of the abruptly expanded portion just above the basal sheath, reminding Ruiz and Pavón of pine needles (as indicated by the old epithet *pinifolia*). The leaves are about eight per whorl at the mid-cauline nodes, more numerous at the proximal nodes, with the bases united into a sheath, which is 8–12 mm on the larger plants. The entire plant above ground forms a dense cylinder 2–6 cm in diam. In *G. weigendii* the basal leaves are fewer and wider, 7–12 cm × 4–13 mm; the distal cauline leaves are lance-triangular, 2.5–7 cm × 7–13 mm; and the leaves are not expanded near the base. The mid-cauline internodes are mostly 4–10 cm and the leaves spread widely, so that much of the stem is visible. The cauline leaves are in whorls of four, separate to the base.

From Gilg's description of *Pitygentias* Gilg, which he segregated from South American *Gentiana* s.l. in 1916, it might be suspected that *Gentianella weigendii* had already been described, but no earlier specific epithet is available for this species. Gilg treated *Pitygentias* as comprising two species, both of which are now included in *Gentianella thyrsoidea* (Fabris, 1958). Although in 1916 Gilg described the nectaries of *Pitygentias* as five calluses between the adnate portions of the stamens, he included in *P. thyrsoidea* (Hook.) Gilg plants that he (Gilg, 1896) had previously described as *Gentiana tupa* Gilg, in which he had said that the nectaries were scarcely conspicuous. The material that he identified as *P. pinifolia* (Ruiz & Pav. ex G. Don) Gilg in 1916 included flowers preserved in alcohol, received from August Weberbauer, as well as herbarium specimens. If Weberbauer's botanizing had extended to the range of *Gentianella weigendii*, it might be that Gilg's description of the nectaries of *Pitygentias* was based on alcohol-preserved flowers of *G. weigendii*, whereas the herbarium specimens that he identified as *P. pinifolia* and *P. thyrsoidea*, and earlier as *Gentiana tupa*, represented *Gentianella thyrsoidea*. The name *Gentiana tupa* was based on plants from Diezmo, Peru. A Ruiz and Pavón specimen from Diezmo at BC (according to Ibáñez, 2006), and a Ruiz and Pavón collection (now divided, F and MA) interpreted by Fabris (1958) and Macbride (1959) as an isotype of the name *Gentiana pinifolia*, were both designated by the same unpublished name by Ruiz and Pavón in herb., and both were annotated as *P. pinifolia* by Gilg. These specimens are probably from a single collection, of which I identified a component as *Gentianella thyrsoidea*. The type of the basionym *Gentiana thyrsoidea* Hook. (*Cruikshanks s.n.*, BM) likewise represents the species to which the name *Gentianella thyrsoidea* is currently applied.

Although the similarities of *Gentianella weigendii* to *G. thyrsoidea* and *G. weberbaueri* have been noted above, little evidence, morphological or molecular, exists to indicate the phylogenetic relationships among the South American species of *Gentianella* or between the South American species and those of other continents. Divisions of *Gentianella* (historically included in *Gentiana*) into sections have included all species, or all except *G. magellanica* (Gaudich.) Fabris ex D. M. Moore, in a single section, and divisions of *Gentianella* into segregate genera subsequent to Gilg's recognition of *Pitygentias* have not discussed South American species. Some character states occur in diverse combinations rather than consistently occurring in syndromes, suggesting the frequent occurrence of homeoplasy. Molecular phylogenetic studies have indicated that *Gentianella*, exclusive of a small clade comprising Asiatic species with paired nectaries, is monophyletic (Hagen & Kadereit, 2001), but few South American species have been included in such studies to date.

Weigend et al. (*Weigend et al. 5083*, in sched.) suggested that the flowers of *Gentianella weigendii* might be cleistogamous. Self-pollination has been demonstrated in some Gentianaceae, including some high-altitude grassland species in South America (Freitas & Sazima, 2009), but studies of pollination in South American *Gentianella* have remained speculative, despite the interest engendered by the diverse floral morphology among these species. Gilg (1916) reported that the flowers of *G. thyrsoidea* (as *Pitygentias* spp.) appeared to be cleistogamous, as

indicated by the presence of expanded ovaries with seeds in advanced stages of development even in the youngest flowers he examined. In *G. weigendii*, the perianth concolorous with the leaves and bracts appears to support the hypothesis of cleistogamy, but prominent floral nectaries are not usually associated with autogamous pollination. The productivity of the nectaries as observed in fresh flowers would be of interest. Observations of *G. weigendii* in the field would also be of interest, to see whether its flowers are visited by insects or other pollinators and if so by what kinds, as would experiments to determine whether seed is set in flowers from which potential pollinators are excluded.

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A New Species of *Pyrrosia* (Polypodiaceae) from Madagascar

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ABSTRACT. A new species of *Pyrrosia* Mirb. (Polypodiaceae) with coenosori, which is found in the province Antsiranana in Madagascar, is described as *P. avaratra* Rakotondr. & Hovenkamp, with keys and an illustration.

Key words: Coenosori, IUCN Red List, Madagascar, Polypodiaceae, *Pyrrosia*.

The genus *Pyrrosia* Mirb. consists of 51 species worldwide (Hovenkamp, 1986), although opinions vary strongly on the number of species that should be recognized (Shing & Iwatsuki, 1997). In Madagascar, there are three species, one of which is endemic, *P. niphoboloides* (Baker) M. G. Price. In the Polypodiaceae, the genera *Drymoglossum* C. Presl and *Saxiglossum* Ching have formerly been distinguished, based on the presence of longitudinal coenosori, in many cases accompanied by a pronounced leaf dimorphism. The inclusion of these genera in *Pyrrosia* is supported by molecular data (e.g., Schneider et al., 2004), which show *Drymoglossum* species to be deeply nested inside *Pyrrosia*.

Herein we report a new coenosoroid species of *Pyrrosia* from Madagascar, bringing the total number of species to four, of which two are endemic.

Pyrrosia avaratra Rakotondr. & Hovenkamp, sp. nov. TYPE: Madagascar. Antsiranana: près de Joffreville, dans le Parc National de la Montagne d'Ambre, au campement de Ben Freed, 12°27′S, 49°13′E, 250–500 m, 3–10 Aug. 1993, *O Andrianantoanina & B. Rochsceohclher 279* (holotype, MO-04916389; isotypes, G-00236282, P-00697016, TAN). Figure 1.

Haec species *Pyrrosiae rhodesianae* similis, sed ab ea frondibus angustioribus atque soris linearibus longitudinalibus differt.

Rhizome shortly elongated, not grooved ventrally, ca. 1.3 mm thick, phyllopodia ca. 3–12 mm apart, lateral buds situated to 1/3 down the internodia; rhizome anatomy, with the ground tissue parenchymatous, sclerenchyma sheath absent, sclerenchyma strands absent; vascular strands 7; rhizome scales peltate, 2.8–3.1 × 0.5–0.6 mm; base irregularly dentate; acumen light brown, strongly dentate. Leaves monomorphic, sessile or indistinctly stipitate; stipes to 0.5 cm; lamina, index ± 20:1; widest at or above the middle, 7–20 × 0.5 cm (when dry, but 0.7 cm in fresh state), base gradually narrowed, apex ± narrowly acute; venation indistinct, without secondary veins, 2 complete and 1 incomplete marginal rows of areoles present; included veinlets rare, simple, free, excurrent; hydathodes distinct, mostly marginal, somewhat sunken; lamina ± 0.3 mm thick, anatomy with upper epidermis with distinctly projecting cells with thin walls, hypodermis composed of a single discontinuous layer, palisade and spongy parenchyma distinct, lower epidermis with moderately thickened cell walls; stomata sunken, pericytic; indument on lower lamina surface dimorphic, a dense mat, persistent, light brown; composed of an upper layer with hairs ca. 1 mm diam., with 6 to 11 ± appressed, acicular rays, and a dense lower layer composed of hairs with woolly rays. Sori elongated or linear, longitudinal, forming an interrupted or continuous coenosorus ca. 1 mm wide at ca. halfway between costa and margin; developing simultaneously, when old distinct, just emerging from the indument. Sporangia on stalks to ± 1/2× as long as the capsule, capsule ± 0.4 mm high, with 23 or 24 indurate annulus cells; paraphyses not differentiated; spores 75–80 × 45–50 μm, sparsely granulate to shallowly verrucate.

Distribution and habitat. Pyrrosia avaratra is endemic to the north of Madagascar. It is found only on the western slopes of the Montagne d'Ambre (Parc national de la Montagne d'Ambre), south of Antsiranana, and in Binara and Antsahabe, in the protected forest of Loky–Manambato, southwest of Daraina. It was observed as an epiphyte in evergreen or semi-deciduous forest, at 500–1230 m.

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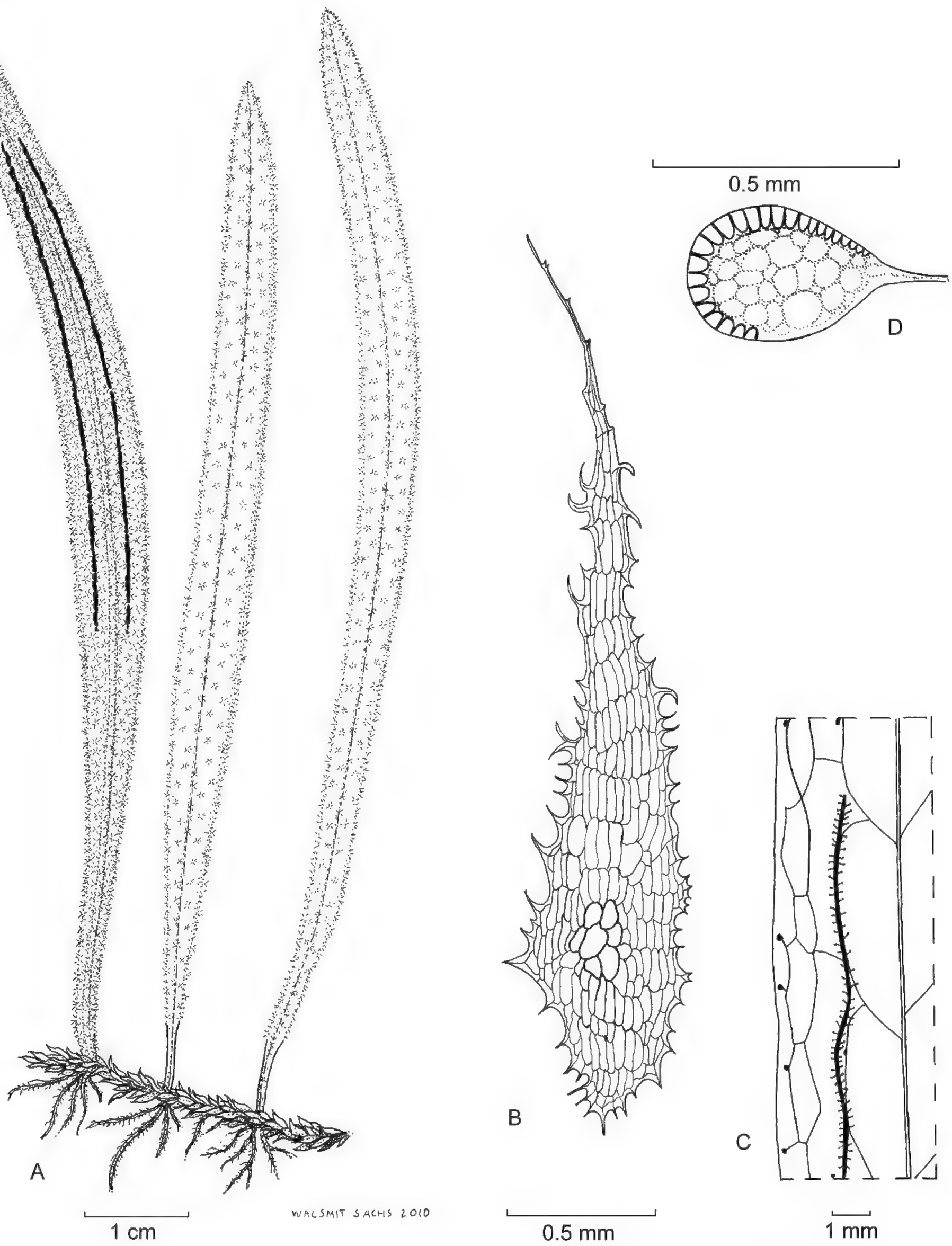

Figure 1. *Pyrrosia avaratra* Rakotondr. & Hovenkamp. —A. Habit. —B. Rhizome scale. —C. Venation with elongated soral receptacle. —D. Sporangium. Drawing by A. Walsmit Sachs, from *Nusbaumer et al. 2429* (L).

IUCN Red List category. *Pyrrosia avaratra* occurs in two locations that are 110 km apart, resulting in an extent of occurrence of 2200 km^2. It is known from three subpopulations, with the number of individuals in each currently unknown. The area of occupancy can be estimated as 160–170 km^2. All subpopulations are located within protected areas, but the forests in which they occur are fragmented and threatened by anthropogenic pressures such as fire and grazing. Based on these data, we consider an assessment of Endangered (EN) as justified (IUCN, 2001).

Etymology. The epithet *avaratra* means "north" in the Malagasy language.

Discussion. *Pyrrosia avaratra* shares most characters with *P. rhodesiana* (C. Chr.) Schelpe, e.g., the shortly elongated, unsclerified rhizome, the peltate, dentate scales, the monomorphic leaves without a distinct stipe, the dimorphic indument, and the

sparsely verrucate spores. The new species is distinctly different in the narrowed lamina with coenosori and the associated simplification of the venation.

The presence of longitudinal coenosori in a species apparently unrelated to either *Pyrrosia niphoboloides* [≡ *Drymoglossum niphoboloides* Baker] or *P. angustissima* (Giesenh. ex Diels) Tagawa & K. Iwats. [≡ *Saxiglossum angustissimum* (Giesenh. ex Diels) Ching] once more confirms that this character is variable within the genus and provides no basis to distinguish separate genera.

In the key to *Pyrrosia* (Hovenkamp, 1986), *P. avaratra* would key out at couplet 8, which should be modified as follows:

8a. Paraphyses absent or inconspicuous, included free veins rare or recurrent 8.5
8b. Paraphyses abundant, free veins many, excurrent 11
8.5a. Fronds monomorphic ..... *P. avaratra*
8.5b. Fronds dimorphic, often distinctly succulent 9

The four species of *Pyrrosia* occurring in Madagascar can be distinguished as follows:

1a. Leaves distinctly dimorphic, fertile and sterile fronds usually both present, clearly different; sori marginal; rhizome scales with cilia that are often longer than the width of the scale ... *P. niphoboloides*
1b. Leaves monomorphic, the fertile ones similar to the sterile (if present); sori on the lamina; rhizome scales dentate or ciliate with cilia shorter than the width of the scale 2
2a. Sori forming a single longitudinal coenosorus between midrib and margin ..... *P. avaratra*
2b. Sori round or elliptic, but always in several rows between midrib and margin 3
3a. Sori on the apical part of the lamina, with a central tuft of stellate paraphyses; stellate hairs on the lamina apressed, with flattened rays ... *P. lanceolata* (L.) Farw.
3b. Sori spread over the entire surface of the lamina, without a central tuft of stellate paraphyses; stellate hairs on the lamina with long, spreading, narrowly cylindrical rays ..... *P. rhodesiana* (C. Chr.) Schelpe

Paratypes. MADAGASCAR. **Antsiranana:** parc nat. de la Montagne d'Ambre, environ 4 km OSO du gîte d'étape, *S. T. Malcomber & S. Rapanarivo 1198* (MO, P); sous préfect. Vohémar, commun. Daraina, *L. Nusbaumer & P. Ranirison 1332* (G, P); Montagne d'Ambre, versant O, *L. Nusbaumer, L. Gautier, P. Ranirison, S. M. Trigui, M. H. Razanajatovo & S. D. Ramandimbimanana 2429* (G, L, P), *L. Nusbaumer, L. Gautier, P. Ranirison 2489* (G, P); parc nat. de la Montagne d'Ambre, SO de la station des Roussettes, forêt d'Ampamelonabe, *F. Rakotondrainibe 1620* (P); Montagne d'Ambre, versant O, *F. Rakotondrainibe 1774* (P); Vohémar, Daraina, forêt de Binara, *F. Rakotondrainibe & H. Rasolohery 6450* (L, P, TAN).

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Taxonomic Notes on *Astragalus prilipkoanus* Group of *Astragalus* sect. *Incani* (Fabaceae) in Iran

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ABSTRACT. *Astragalus mishodaghmontanus* Ranjbar, Karamian & Nouri, a singular new species endemic to Iran, is described and illustrated. The new species belongs to subgenus *Cercidothrix* Bunge, section *Incani* DC., in *Astragalus* L. (Fabaceae). It is distributed in northwestern Iran in East Azerbaijan Province. *Astragalus mishodaghmontanus* is closely related to *A. prilipkoanus* Grossh. and *A. hashtrudicus* Ranjbar, but is distinguished by its glabrous pods with minute dark reddish dots. The IUCN conservation status of the new species is evaluated as Vulnerable (VU). Results from cytogenetic analysis indicate that *A. mishodaghmontanus* is a diploid species ($2n = 2x = 16$), with this chromosome number consistent with the proposed base number of $x = 8$ for the genus. Meiosis was observed as regular, with bivalent pairing and normal chromosome segregation.

Key words: *Astragalus*, chromosome number, East Azerbaijan, Fabaceae, Iran, IUCN Red List, section *Incani*, subgenus *Cercidothrix*.

Astragalus L. is a large genus (Fabaceae, Papilionoideae, Astragaleae) occurring in the cold, mountainous regions of Europe, Asia, and North America, and is particularly abundant in central and southwestern Asia (Yakovlev et al., 1996; Ranjbar & Karamian, 2003a, 2003b). By species number, *Astragalus* may be the largest genus of vascular plants, represented by ca. 2500 taxa (Lock & Simpson, 1991; Mabberley, 1997; Maassoumi, 1998; Ranjbar & Karamian, 2002). *Astragalus* is certainly the most speciose genus in Iran, and section *Incani* DC. (subgenus *Cercidothrix* Bunge) is one of its largest sections, with ca. 70 species in Iran (Podlech & Maassoumi, 2003; Ranjbar & Karamian, 2003a; Ranjbar et al., 2005; Ranjbar, 2007) of ca. 120 species worldwide (Lock & Simpson, 1991; Yakovlev et al., 1996).

Cytological studies in the tribe have concentrated on chromosome counts. The basic chromosome number of $x = 8$ in two ploidy levels ($2n = 2x = 16$, $2n = 4x = 32$) has been reported for Eurasian *Astragalus* (Aryavand, 1983; Maassoumi, 1987a, 1987b, 1998; Sheidai et al., 1996, 2000; Bader & Sherif, 2007; Ranjbar et al., 2010a, 2010b, 2010c, 2011). However, karyotypic data on the interspecific and phylogenetic relationships and on meiotic behavior are still limited. Within section *Incani* there are limited chromosome counts for a few *Astragalus* species from Iran, with an interesting occurrence of mixoploidy in this section (Maassoumi, 1987a, 1987b, 1998; Ranjbar et al., 2010c, 2011).

Field research in East Azerbaijan Province in 2009 led to the discovery of a divergent population of *Astragalus* occurring sympatrically with populations of *A. hashtrudicus* Ranjbar near Marand. Our studies on living material and herbarium specimens showed that this new taxon, which occurs exclusively in the Misho-Dagh Mountains, is similar to *A. hashtrudicus* and *A. prilipkoanus* Grossh. However, morphological differences suffice to treat this as a new distinctive species.

METHODS

Morphology. Plants from different populations of *Astragalus* sect. *Incani* in northwestern Iran were collected and vouchers were preserved in BASU. These species were also studied in the field, and excursions in Iran, principally in East Azerbaijan, provided information about the ecological and soil conditions under which perennial *Astragalus* can grow. Because the length and shape of flower parts are important for delimitating *Astragalus* species, flower dissections were made from the new taxon.

Cytogenetics. Fifteen young flower buds from at least five plants of the new taxon were collected and fixed in modified Carnoy's solution in ethyl alcohol (96%), chloroform, and propionic acid (6:3:2) for 24 hr. at room temperature, then stored in 70% ethyl alcohol at 4°C. Anthers were squashed and stained with 2% (w/v) acetocarmine, and all slides were made permanent by the Venetian turpentine method (Wilson, 1945). Micrographs of chromosomes were taken on an Olympus BX-41 photomicroscope (Tokyo, Japan), using an initial magnification of ×1000. Chromosome counts were made from intact cells with well-spread metaphasic chromatids.

Astragalus mishodaghmontanus Ranjbar, Karamian & Nouri, sp. nov. TYPE: Iran. East Azerbaijan: Marand to Sufian, after Shirdagh, subalpine near Marand, 1626 m, 13 June 2008, *M. Ranjbar 19161* (holotype, BASU; isotypes, MO, TARI, W). Figure 1.

Haec species *Astragalo prilipkoano* Grossh. affinis, sed ab eo foliis 12–34 (nec 10–14) cm longis, foliolis utrinque saepe (nec semper) minute atropurpureo-punctatis pedunculo 24–38 (nec ca. 15) cm longo atque leguminibus glabris (nec trichomatibus albis atque nigris vestitis), ab *Astragalo hashtrudo* Ranjbar petiolo 5–15 (nec usque ad 18) cm longo, foliolis utrinque saepe minute atropurpureo-punctatis (nec utrinque epunctatis), pedunculo 24–38 (nec 45–60) cm longo, ovariis glabris (nec trichomatibus albis vestitis) atque leguminibus glabris (nec trichomatibus saepissime albis vestitis) 21–23 × 3–4 mm (nec 18–23 × 3.5–5 mm) differt.

Plants to 50 cm tall, densely pubescent with appressed, symmetrically medifixed, mostly white trichomes, 0.3–1 mm; caudex to 25 mm diam., mostly with a pluricipital root crown, branches short, thick, covered with blackened remnants of old stipules and petioles. Stipules 7–12 × 4–7 mm, triangular acuminate, adnate to the petiole for 2.5–3 mm, densely pubescent; leaves 12–34 cm; petioles 5–15 cm, striate, 1–2 mm thick, white pubescent, leaflets in 8 to 12 pairs, elliptic to broadly elliptic or rarely orbicular, round-tipped and mucronulate, 5–20 × 3–9 mm, on both sides loosely pubescent, often spotted with minute dark reddish dots. Peduncles 24–38 cm, to 4 mm thick, rounded, densely pubescent; racemes densely flowered, 25 to 40, elongated in fruit to 20 cm long; bracts linear to narrowly triangular, 2–4 × 1–1.5 mm, glabrous, ciliate or sometimes with a few black and white trichomes; pedicels 2–3 mm. Flowers erect or rarely spreading; bracteoles ca. 0.2–0.5 mm; calyx 9–11 mm, tubular, slightly gibbous at base, oblique, loosely covered with medifixed, appressed black trichomes (0.3–0.5 mm) with rarely a few white trichomes mixed in (0.8 mm); calyx teeth narrowly linear to minutely triangular, 0.5–1.25 mm; corolla violet, standard 22–28 mm, limb 8–10 mm wide, elliptic, narrowed into a long tongue-like appendix, to 4 mm wide, rounded at tip, gradually narrowed into a short claw, wings 19–20 mm; limbs oblong, 10–11 × 2.5–3 mm, auricle very short, keel 15–18 mm; blades obliquely oblong, with curved lower edge and nearly straight upper edge, acute to subacute at the apex, 7–9 × 3–4 mm; claw 8–9 mm; stamen tube truncate at the mouth; ovary with a stipe ca. 0.5 mm, linear, glabrous; long style persistent, glabrous. Legumes mature, glabrous, sessile, erect, linear, straight, 21–23 × 3–4 mm, with an oblique beak to 2 mm, bilocular; valves pale greenish purple, glabrous.

Etymology. The species epithet is taken from the type locality in the Misho-Dagh Mountains.

Phenology. Flowering was observed to occur in May and June; fruit ripening occurred from June to August.

Distribution and habitat. *Astragalus mishodaghmontanus* is endemic to northwestern Iran and is known only from the type locality. It was collected from dry steppe and clay zones along roadsides.

IUCN Red List category. We observed a very low frequency of *Astragalus mishodaghmontanus* in one field locality and therefore classify this species as Vulnerable (VU), a category that includes taxa with small populations that could be at risk, according to IUCN criteria (IUCN, 2001). No more than 15 individual plants were observed as sparsely scattered in an area of ca. 100 km² in the Misho-Dagh Mountains.

Taxonomic discussion. The new species is closely related to *Astragalus prilipkoanus* and *A. hashtrudicus*, especially in its similar indumentum, number of leaflets, and the shape, size, and arrangement of pods. These species belong to *Astragalus* sect. *Incani*, to which *A. mishodaghmontanus* is assigned. The new species differs from these allied taxa by its glabrous ovary and glabrous, mature, pale greenish purple pod.

KEY TO THE SPECIES OF THE *ASTRAGALUS PRILIPKOANUS* GROUP

1a. Ovary and pod glabrous ..... *A. mishodaghmontanus*
1b. Ovary and pod pubescent 2
  2a. Peduncle to 60 cm, leaves 15–30 cm, pods densely covered with appressed white trichomes, leaflets not spotted with minute dark red dots ..... *A. hashtrudicus*
  2b. Peduncle to 15(–40) cm, leaves 10–14 cm, pods densely covered with appressed white and black trichomes, leaflets spotted with minute dark red dots ..... *A. prilipkoanus*

All *Astragalus* species studied for section *Incani* share a basic chromosome number of $x = 8$. More than 50% of the 70 species in Iran are diploid ($2n = 2x = 16$), and remaining taxa are allotetraploid with $2n = 2n = 4x = 32$ (Ranjbar et al., 2010b, 2011). *Astragalus mishodaghmontanus* is diploid and possesses $2n = 2x = 16$ chromosomes, consistent with a base number of $x = 8$ (Fig. 1I). The general meiotic behavior in the new species was regular, with bivalent pairing and normal chromosome segregation.

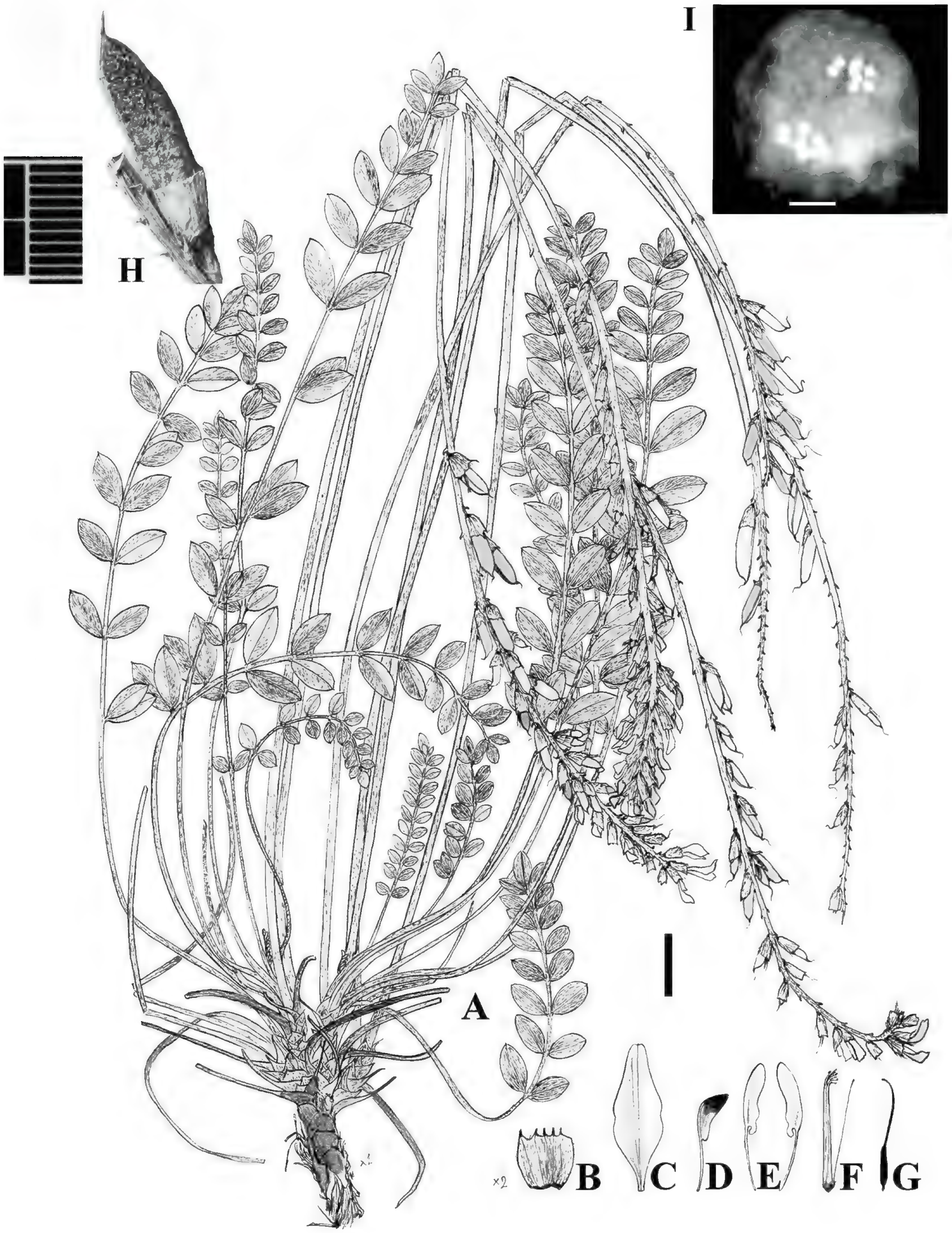

Figure 1. *Astragalus mishodaghmontanus* Ranjbar, Karamian & Nouri. —A. Habit with details of flower and pod. —B. Calyx. —C. Standard. —D. Keel. —E. Wings. —F. Androecium. —G. Pistil. —H. Pod. —I. Telophase I in *A. mishodaghmontanus*. Drawn from the holotype *Ranjbar 19161* (BASU). Scale bar: A = 2 cm; B–G = 1 cm; H = 1 cm; I = 6 μm.

Paratype. IRAN. **East Azerbaijan:** Varzaghan toward Tabriz, 20 km after Varzaghan, 1545 m, 26 May 2011, *M. Ranjbar & S. Nouri 26846* (BASU).

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Staelia catolensis (Rubiaceae), una Nueva Especie de Catolés, Bahia, Brasil

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Resumen. *Staelia catolensis* R. M. Salas & E. L. Cabral, una nueva especie (Rubiaceae, Spermacoceae) de Bahia, Brasil, es descrita e ilustrada. El nuevo taxón es aparentemente endémico de Serra de Catolés en áreas de campos rupestres. *Staelia catolensis* es similar a *S. thymoides* Cham. & Schltdl. en el hábito pequeño e inflorescencias con crecimiento determinado y puede distinguirse de esta última por las hojas aciculares con ápice punzante, corola externamente papilosa y granos de polen microreticulados.

Abstract. *Staelia catolensis* R. M. Salas & E. L. Cabral, a new species (Rubiaceae, Spermacoceae) from Bahia, Brazil, is described and illustrated. The new taxon is apparently endemic from the Serra de Catolés in areas of campos rupestres. The new species resembles *S. thymoides* Cham. & Schltdl., with which it shares a small stature and determinate inflorescence. *Staelia catolensis* differs by its acicular leaves with a pungent tip, the external indumentum of the corolla, and the pollen grains with microreticulate exine.

Key words: Chapada Diamantina, IUCN Red List, Rubiaceae, Spermacoceae, *Staelia*.

Staelia Cham. & Schltdl. (Rubiaceae) es exclusivamente sudamericano y cuenta con 18 especies (Salas & Cabral, 2010a, 2011a, 2011b) que habitan preferentemente en áreas secas de Argentina (bosque seco chaqueño), Bolivia (bosque seco chaqueño y chiquitano), Brasil (especialmente caatinga y cerrado), Paraguay (cerrado y bosque seco chaqueño) y Uruguay (campos).

El género pertenece a la tribu Spermacoceae y dentro de ésta constituye uno de los pocos taxones cuya monofilia se sustenta en la morfología del fruto (Dessein, 2003). Se diferencia de los demás géneros por la dehiscencia longitudinal-oblicua, que separa al fruto en tres partes, dos valvas apicales caducas y una basal que persiste en la planta. La dehiscencia comienza desde el ápice hasta la mitad, siguiendo la sutura de los carpelos (septicida) y desde allí sigue una línea oblicua hacia abajo (loculicida).

Recientemente, tres especies fueron separadas de los límites de *Staelia*. *Staelia capitata* K. Schum. y *S. lanigera* (DC.) K. Schum. fueron transferidas a un nuevo género denominado *Planaltina* R. M. Salas & E. L. Cabral (Salas & Cabral, 2010b), mientras que *S. scabra* (C. Presl) fue reducida a sinónimo de *Tessiera lithospermoides* DC. (Salas & Cabral, 2010c).

En *Staelia* se describieron recientemente nuevas especies de Argentina (Cabral & Salas, 2005), Bolivia (Salas & Cabral, 2006a), Brasil (Salas & Cabral, 2006b, 2011a, 2011b) y Paraguay (Salas & Cabral, 2010a). En continuidad con la revisión del género se presenta una especie nueva del estado de Bahia, Brasil encontrada dentro del complejo de la Chapada Diamantina en el distrito de Catolés.

Staelia catolensis R. M. Salas & E. L. Cabral, sp. nov. TIPO: Brazil. Bahia: Catolés, gerais da Serra da Tromba, encosta da Serra do Atalho, 13°6′S, 41°54′W, 1350 m, 18 jun. 1992, *W. Ganev 519* (holotipo, HUEFS; isotipos, K no visto, SPF). Figuras 1, 2.

Haec species *Staeliae thymoidi* Cham. & Schltdl. similis, sed ab ea foliis acicularis crassis rigidis pungentibus, corollis abaxialiter papillosis et pollinis granis microreticulatis differt.

Sufrútice 5–10 cm, muy ramificado desde la base; tallos cilíndricos, pubescentes. Hojas 3–6 × 0.2–0.5 mm, aciculares, base levemente atenuada, ápice mucronado, punzante, levemente crasas, de sección hemicircular, nervio primario escasamente visible; vaina estipular 0.5–0.7 mm, glabrescente o pubescente, con pelos cerca del borde tan largos como las lacinias, con 3 lacinias, glabras, crasas. Inflorescencia con crecimiento determinado, inflorescencias parciales en glomérulos multifloros, 1 apical y 1(2) subapicales; brácteas 2, foliáceas; bractéolas 0.2–1.3 mm, filiformes con ápice glandular. Flores sésiles; hipanto glabrescente o pubescente en la mitad superior; cáliz 2-lobado, tubo 0.1–0.2 mm, lóbulos 1.3–1.8 mm, linear-subulados, glabros con márgenes pubescentes; corola 4–5.2 mm, blanca, 4-lobada, externamente con notorias papilas, internamente con

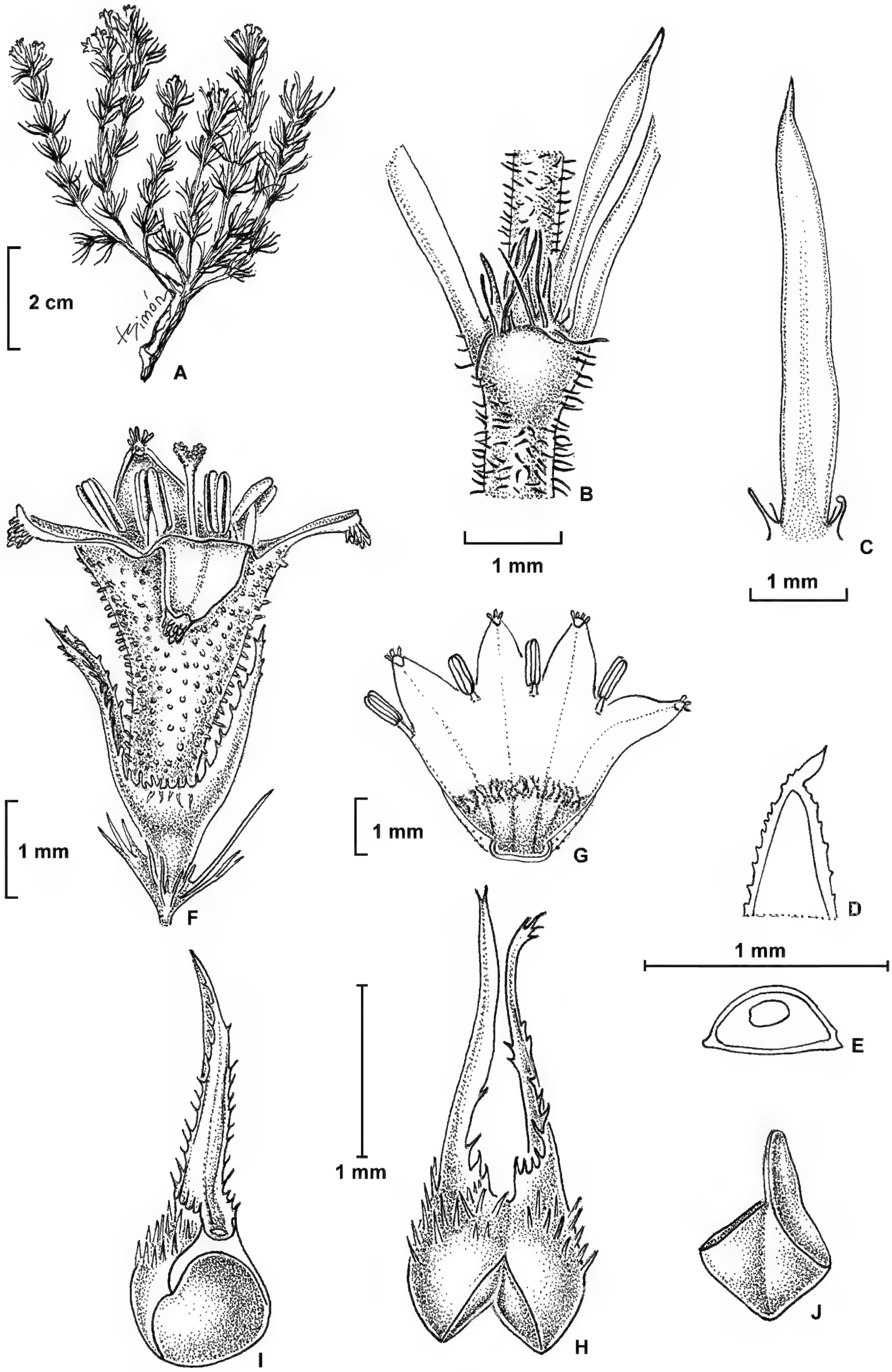

Figura 1. *Staelia catolensis* R. M. Salas & E. L. Cabral. —A. Hábito. —B. Vaina estipular. —C. Hoja. —D. Ápice de hoja. —E. Sección transversal de hoja. —F. Flor. —G. Corola abierta. —H. Valvas del fruto inmaduro. —I. Vista interna de valva caduca. —J. Porción persistente del fruto. Todo del holotipo *Ganev 519* (HUEFS).

anillo de pelos moniliformes cerca de la base del tubo; estambres exertos, más cortos que los lóbulos corolinos; estilo 4.5–5.3 mm, filiforme, estigma bífido, papiloso. Cápsula obovoide, glabrescente o pubescente solo en la mitad superior; semilla inmadura, cara dorsal sin surcos.

Staelia catolensis comparte con *S. thymoides* Cham. & Schltdl., el hábito pequeño y las inflor-

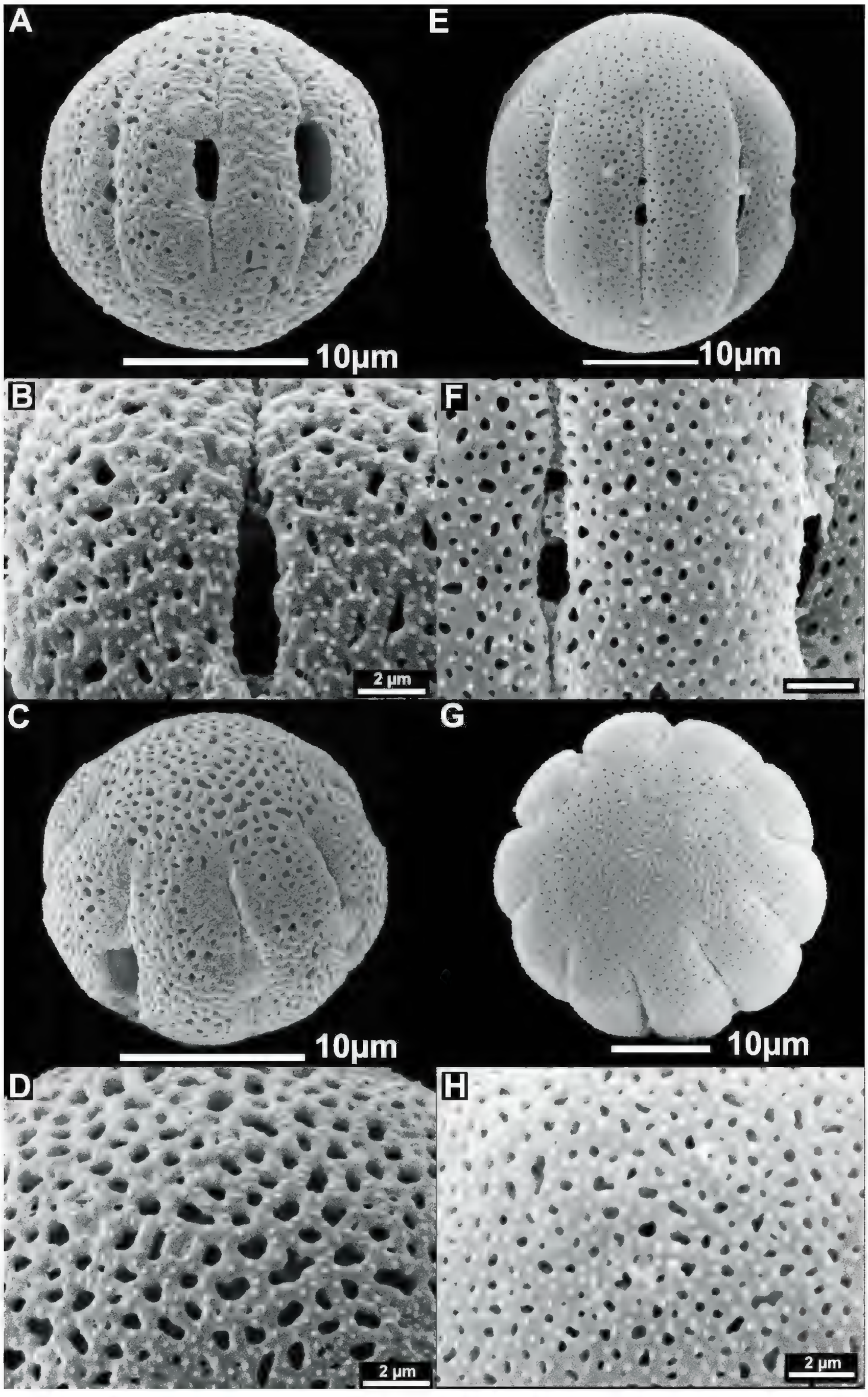

Figura 2. Microfotografías electrónicas. A–D. *Staelia catolensis* R. M. Salas & E. L. Cabral (de *Ganev 519*, HUEFS). —A. Vista ecuatorial. —B. Detalle de mesocolpio. —C. Vista subpolar. —D. Detalle de apocolpio. E–H. *Staelia thymoides* Cham. & Schltdl. (de *Krapovickas 45168*, CTES). —E. Vista ecuatorial. —F. Detalle de mesocolpio. —G. Vista polar. —H. Detalle de apocolpio.

escencias con crecimiento determinado, mientras que difiere en las hojas aciculares con apículo punzante, levemente crasas, de sección hemicircular, de 3–6 × 0.2–0.5 mm (vs. hojas lineares con ápice no punzante, papiráceas y de sección aplanada, de 5–20 × 1–2.5), corola externamente papilosa (vs. glabra o pubescente) y granos de polen con exina microreticulada (vs. tectado-perforada). Por otro lado, *S. thymoides* es una especie que habita en el noreste de Argentina, noroeste de Rio Grande do Sul, Brasil, sur de Paraguay oriental y noroeste de Uruguay en áreas de campos o pastizales primarios o modificados.

Staelia catolensis presenta una inflorescencia con crecimiento determinado, por lo que todas sus ramas floríferas tienen sus meristemas apicales consumidos en glomérulos terminales. Esta característica es compartida no sólo por *S. thymoides*, sino también por *S. hatschbachii* J. H. Kirkbr. (Endémica de Grão Mogol, Minas Gerais). De acuerdo a Weberling (2007), este tipo de inflorescencia está relacionado al hábito anual, lo cual se pudo comprobar en invernáculo en *S. thymoides*.

Los especímenes examinados se encuentran identificados en los tres herbarios como *Staelia catechosperma* K. Schum. [≡ *Anthospermopsis catechosperma* (K. Schum.) J. H. Kirkbr.], de la cual puede ser diferenciada por ser un sufrútice ramificado desde la base (vs. arbusto con eje simple ramificado apicalmente), por las hojas aciculares de sección hemicircular y punzante (vs. hojas angostamente elípticas o elípticas, sección plana y ápice no punzante); cápsula con dehiscencia longitudinal y oblicua, valvas separadas de las semillas (vs. cápsula con dehiscencia longitudinal, valvas con semillas inclusas después de la dehiscencia y septo intercarpelar cordado).

Distribución y hábitat. Esta especie está restringida a Bahia, Brasil, dentro del complejo de la Chapada Diamantina en Serra de Catolés. En esta región se realizaron exhaustivas colecciones botánicas por investigadores brasileños y británicos desde 1983 hasta el presente. De esta colección, se conoce al único espécimen de *Staelia catolensis*. El Sr. Wilson Ganev (colector del holotipo), residente local y guía experto del distrito de Catolés, junto a otros coleccionistas (R. M. Harley y D. J. N Hind de K y L. P. Queiroz de HUEFS, entre otros) realizó en esa región innumerables viajes de colección entre 1983 y 1995; dichos especímenes fueron depositados principalmente en los herbarios HUEFS, K y SPF. El análisis de esas colecciones, permite sugerir que el material tipo representa probablemente la única población hasta ahora conocida de *S. catolensis*.

Esta especie proviene de áreas de campos rupestres, vegetación que en el distrito de Catolés se encuentran bien representada entre 1200 y 1700 m. El área se caracteriza por suelos arenoso-pedregosos, ocasionalmente anegadizos, con numerosos afloramientos rocosos. La vegetación predominante está representada por plantas leñosas, de porte pequeño y perennifolias, las hojas, tallos y raíces presentan generalmente adaptaciones xeromórficas (hojas esclerificadas, coriáceas, suculentas o con indumentos particulares), lo que les permite sobrevivir a los grandes cambios térmicos, a la gran variabilidad hídrica y a los efectos del fuego (Zappi et al., 2003). La región de Catolés, se caracteriza además por más de 30 especies endémicas, la mayoría recientemente descritas y entre las cuales se incluye un género denominado *Catolesia* D. J. N. Hind. En cuanto a la tribu Spermacoceae, fue descrita recientemente *Borreria catolensis* E. L. Cabral & L. M. Miguel basada en colecciones de los municipios Abaíra y Piatã (Cabral et al., 2011).

IUCN Red List category. Debido a que se conoce una única colección en los últimos 19 años en un área relativamente bien colectada, se le asigna una categoría de amenazada de acuerdo a los criterios de IUCN (2001), por lo tanto consideramos a *Staelia catolensis* en Peligro Crítico: CR B2a,b(iv).

Morfología polínica. Los granos de polen fueron analizados bajo microscopio óptico y electrónico de barrido, la descripción se basa en la observación de 20 granos. Descripción bajo MO: granos (7 a)8 zonocolporados, esferoidales, isopolares y radiosimétricos. Tamaño mediano (P = 24–26.7 y E = 24.6–25.7 µm). Colpos largos, de 17.5–18.3 µm (ECA/P: < 0.46). Endoabertura en endocíngulo, 4–7 µm de largo. Exina de 2.2–2.7 µm de espesor, sexina igual o más gruesa que la nexina. MEB: exina microreticulada, heterobrocada, lúmenes 0.1–1.2 µm de diámetro, circulares, alargados o irregulares, levemente mayores y densos en el apocolpio, muros 0.4–0.6 µm de ancho, con espínulas 0.1–0.2 µm, uniformemente distribuidas en todo el grano (Fig. 2A–D). El polen de *Staelia thymoides* fue descrito por Salas y Cabral (2010a) como de tamaño mediano (P = 29 µm y E = 27.5 µm), (−7)8-colporado y colpos de 16–21 µm. Los autores también señalan que las especies por ellos analizadas presentan el polen morfológicamente muy similar. Las principales diferencias en cuanto al hábito, hojas, polen, distribución y ambientes de *S. thymoides* y *S. catolensis* se resumen en la Tabla 1.

Tabla 1. Comparación morfológica, palinológica y geográfica entre *Staelia catolensis* R. M. Salas & E. L. Cabral y *S. thymoides* Cham. & Schltdl.

Caracteres morfológicos	*S. catolensis*	*S. thymoides*
Altura (cm)	5–10	(10–)15–35
Hoja tamaño (mm)	3–6 × 0.2–0.5	5–20 × 0.5–2.5
Ápice	con apículo punzante	atenuado, no punzante
Consistencia	levemente crasa, coriácea cuando seca	papirácea
Sección transversal	hemicircular	aplanada
Vaina estipular	con pelos cerca del borde tan largos como las lacinias	con pelos mucho más cortos que las lacinias
Superficie externa de la corola	con papilas notorias, más marcadas en el dorso de los lóbulos	glabra o pubescente, con escasas papilas en el dorso de los lóbulos
Relación estambre/lóbulo corolino	estambres más cortos que los lóbulos	estambres más largos que los lóbulos
Tubo calicino (mm)	0.1–0.2	ausente
Polen tamaño (µm)	P = 24–26.7 y E = 24.6–25.7	P = 26.6–35.5 y E = 27.3–31.8
Exina	microreticulada	tectado-perforada
Distribución	endémica de Bahia, Brasil	NE Argentina, S Paraguay, NO Uruguay y NO de Rio Grande do Sul, Brasil
Ambiente, altitud	campos rupestres, c. 1350 m	pastizales y campos, 100–350 m

Las hojas aciculares y los granos de polen microreticulados son documentados por primera vez en *Staelia*.

Agradecimientos. Se agradece a Laura Simón por el pasado a tinta de los detalles y confección del porte, y a los curadores de HUEFS y SPF. A Laila Miguel por su asistencia en la preparación del polen. El primer autor agradece por el otorgamiento de las becas de investigación Tipo I y II del Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET). Este trabajo es parte de los resultados de la revisión del género y tema de tesis de doctorado del primer autor. Se agradece también a lo revisores y editores, quienes mejoraron notablemente la versión final de este trabajo.

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New Combinations in North American *Schoenoplectiella* (Cyperaceae)

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ABSTRACT. An investigation of taxonomic diversity in the North American members of *Schoenoplectus* (Rchb.) Palla and *Schoenoplectiella* Lye indicates the need to relocate species and varieties from *Schoenoplectus* sect. *Actaeogeton* (Rchb.) J. Raynal to *Schoenoplectiella*. A transfer of four taxa is proposed here: *Schoenoplectiella purshiana* (Fernald) Lye var. *williamsii* (Fernald) Shiels & Monfils, *S. smithii* (A. Gray) Shiels & Monfils var. *smithii*, *S. smithii* var. *leviseta* (Fassett) Shiels & Monfils, and *S. smithii* var. *setosa* (Fernald) Shiels & Monfils.

Key words: bulrush, Cyperaceae, *Schoenoplectiella*, *Schoenoplectus*, systematics, taxonomy.

Schoenoplectus (Rchb.) Palla s.l. has four sections designated by morphological and ecological data (Raynal, 1976; Smith & Hayasaka, 2001): *Schoenoplectus* sect. *Schoenoplectus*, *Schoenoplectus* sect. *Malacogeton* (Ohwi) S. G. Sm. & Hayasaka, *Schoenoplectus* sect. *Actaeogeton* (Rchb.) J. Raynal, and *Schoenoplectus* sect. *Supini* (Cherm.) J. Raynal. Species within *Schoenoplectus* sect. *Schoenoplectus* and *Schoenoplectus* sect. *Malacogeton* are perennials and have yellow to dark brown smooth achenes. Species within *Schoenoplectus* sect. *Actaeogeton* and *Schoenoplectus* sect. *Supini* are annuals or perennials and have light brown to black striate achenes. Species in *Schoenoplectus* sect. *Schoenoplectus* have stout rhizomes and floral scales with distinctly emarginate apices, while species in *Schoenoplectus* sect. *Malacogeton* have slender rhizomes often terminating in fleshy tubers and floral scales with entire or minimally emarginate apices. Species in *Schoenoplectus* sect. *Supini* often display amphicarpy and all have one or two nodes with cauline leaves, while species in *Schoenoplectus* sect. *Actaeogeton* never display amphicarpy and have nodeless culms with basal leaves. According to Govaerts et al. (2012), there are 76 species in *Schoenoplectus* s.l.; ca. 25 of these are not assigned to a section in the sectional accounts of Raynal (1976) and Smith and Hayasaka (2001).

Lye (2003) recognized the polyphyly of *Schoenoplectus* and proposed a revision resulting in a more narrowly defined *Schoenoplectus* and a newly erected genus, *Schoenoplectiella* Lye. This revision relied heavily on the molecular phylogenetic analyses of Muasya et al. (1998, 2000), which, combined, included two species of *Schoenoplectus* sect. *Schoenoplectus* (*Schoenoplectus lacustris* (L.) Palla and *Schoenoplectus triqueter* (L.) Palla) and two species from *Schoenoplectus* sect. *Supini* (*Schoenoplectiella juncea* (Willd.) Lye and *Schoenoplectiella articulata* (L.) Lye). Muasya et al. (2000) found *Schoenoplectus lacustris* (the type species for *Schoenoplectus*) more closely related to *Actinoscirpus* (Ohwi) R. W. Haines & Lye and *Bolboschoenus* (Asch.) Palla than to the sampled congeners from *Schoenoplectus* sect. *Supini*. In 2003, Lye transferred 26 species from *Schoenoplectus* s.l. into *Schoenoplectiella*: 23 species from *Schoenoplectus* sect. *Supini* and three from *Schoenoplectus* sect. *Actaeogeton* (*Schoenoplectiella juncoides* (Roxb.) Lye, *Schoenoplectiella purshiana* (Fernald) Lye, and *Schoenoplectiella wallichii* (Nees) Lye). Lye did not recognize sections in his treatment.

Lye's (2003) generic description of *Schoenoplectiella* relies on the presence of amphicarpy, tropical to subtropical distribution, and the "smaller" annual habit. Amphicarpy is present in *Schoenoplectus* sect. *Supini* but not in the three transferred species from *Schoenoplectus* sect. *Actaeogeton*. In addition, three species that Lye (2003) moved to *Schoenoplectiella* are restricted to North America and can occur in a temperate climate (*Schoeonoplectiella hallii* (A. Gray) Lye, *Schoenoplectiella purshiana*, and *Schoenoplectiella saximontana* (Fernald) Lye). *Schoenoplectiella juncoides* was transferred and is a perennial species with individuals that can reach 70 cm in height (Koyama, 1958). As currently described, not all species in *Schoenoplectiella* fit Lye's (2003) description.

Since Lye established *Schoenoplectiella* in 2003, five phylogenetic studies have been published that include modest sampling of species from *Schoenoplectus* s.l. (Yano & Hoshino, 2005; Simpson et al., 2007; Muasya et al., 2009a, 2009b; Jung & Choi, 2010). These studies include up to 13 species, utilize additional genetic markers, and include sampling from several close relatives in the Fuireneae. In all analyses, species in *Schoenoplectus* sect. *Actaeogeton* and *Schoenoplectus* sect. *Supini* are in a clade separate from species in *Schoenoplectus* sect. *Schoenoplectus* and *Schoenoplectus* sect. *Malacogeton*.

Citing molecular and morphological evidence, Jung and Choi (2010) transferred five species from

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Schoenoplectus sect. *Actaeogeton* to *Schoenoplectiella*. Jung and Choi (2010) point to some inconsistencies in Lye's 2003 description of *Schoenoplectiella* and advocate for revising the genus and subsuming all species from *Schoenoplectus* sect. *Supini* and *Schoenoplectus* sect. *Actaeogeton* into *Schoenoplectiella*. The molecular evidence for the revision is strong; however, further revisions of the generic descriptions are needed to reflect global morphological diversity in *Schoenoplectus* s. str. and *Schoenoplectiella*.

We propose to transfer the remaining North American species and varieties of *Schoenoplectus* sect. *Actaeogeton* into *Schoenoplectiella*; this is consistent with Lye's (2003) initial transfer of species and Jung and Choi's (2010) revision of *Schoenoplectiella*. The following combinations are proposed: *Schoenoplectiella purshiana* (Fernald) Lye var. *williamsii* (Fernald) Shiels & Monfils, *S. smithii* (A. Gray) Shiels & Monfils var. *smithii*, *S. smithii* var. *leviseta* (Fassett) Shiels & Monfils, and *S. smithii* var. *setosa* (Fernald) Shiels & Monfils. The nomenclatural changes proposed here are in preparation for a molecular and morphological study of biodiversity in the North American species of *Schoenoplectus* and *Schoenoplectiella*.

New Combinations in *Schoenoplectiella*

1. Schoenoplectiella purshiana (Fernald) Lye, Lidia 6(1): 26. 2003. Replacement name: *Scirpus purshianus* Fernald, Rhodora 44: 479. 1942. Replaced syn.: *Scirpus debilis* Pursh, Fl. Amer. Sept. 1: 55. 1814 [Dec. 1813], non *Scirpus debilis* Lam., Tab. Encycl. 1: 141. 1791, nec *Scirpus debilis* (Kunth) Kuntze, Revis. Gen. Pl. 2: 757. 1891, nom. illeg. *Schoenoplectus juncoides* (Roxb.) Palla subsp. *purshianus* (Fernald) Soják, Čas. Nár. Mus., Odd. Přír. 141: 62. 1972. *Schoenoplectus purshianus* (Fernald) M. T. Strong, Novon 3: 202. 1993. TYPE: U.S.A. Pennsylvania: "in wet meadows, Pennsylvania," *Muhlenberg s.n.* (lectotype, designated by Strong ["as designated on sheet by Schuyler"], [1993: 203], Hb. Muhlenberg 345–75 [no. 65, m. 33 in sched.] not seen, PH-00031652-3 photo).

1a. Schoenoplectiella purshiana (Fernald) Lye var. **purshiana.**

Habitat and distribution. The autonymic variety of *Schoenoplectiella purshiana* has been suggested to be associated with acidic substrates and stable water level conditions (Schuyler, 1972; Strong, 1994; Smith & Hayasaka, 2002). It has been collected from freshwater shores, ponds, and ditches in eastern North America, with collections from Ontario and Quebec in Canada. In the United States, plants have been documented from Alabama, Connecticut, Delaware, Washington, D.C., Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, Virginia, West Virginia, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. *Schoenoplectiella purshiana* is an herbaceous annual with tufted culms displaying a pseudolateral inflorescence and an erect or divergent involucral bract. The inflorescence consists of one to 12 sessile spikelets. Flowers contain a perianth of six bristles equaling to slightly exceeding the achene or, rarely, are missing perianth bristles; each bristle is distinctly wider proximally. Achenes are widest near the middle and contain a central bulge on the abaxial surface (Smith, 2002). *Schoenoplectiella purshiana* has two varieties designated morphologically by presence or absence of perianth bristles: *S. purshiana* var. *purshiana* and *S. purshiana* var. *williamsii*. *Schoenoplectiella purshiana* var. *purshiana* always has six well-developed perianth bristles.

1b. Schoenoplectiella purshiana var. **williamsii** (Fernald) Shiels & Monfils, comb. nov. Basionym: *Scirpus debilis* Pursh var. *williamsii* Fernald, Rhodora 3: 252. 1901, as "Williamsii." *Scirpus smithii* A. Gray var. *williamsii* (Fernald) Beetle, Amer. J. Bot. 29: 655. [Oct.] 1942. *Scirpus purshianus* fo. *williamsii* (Fernald) Fernald, Rhodora 44: 479. [Dec.] 1942. *Scirpus juncoides* Roxb. var. *williamsii* (Fernald) T. Koyama, Canad. J. Bot. 40: 914. 1962. *Schoenoplectus purshianus* (Fernald) M. T. Strong var. *williamsii* (Fernald) S. G. Sm., Novon 12(1): 107. 2002. TYPE: U.S.A. Massachusetts: [Norfolk Co.] "sandy border of Massapoag Lake, Sharon," 7 Sep. 1901, *E. F. Williams & M. L. Fernald s.n.* [Plantae Exsiccatae Grayanae 26] (holotype, GH-00027993; isotypes, BRIT not seen, CAS-0005832 photo, GH-00027994 not seen, GH-00027995 not seen, GH-00027996 not seen, ILL not seen, MO-208586 not seen, MT, NEBC not seen, SAPS not seen, UC not seen, WTU not seen).

Habitat and distribution. *Schoenoplectiella purshiana* var. *williamsii* has been associated with acidic substrates and fluctuating water level conditions (Schuyler, 1972; Strong, 1994; Smith & Hayasaka, 2002). Collections have been found on sandy shores of freshwater lakes, muddy terraces along

streams, disturbed areas with gravel pits, and small ponds and marshy areas in the eastern United States from Indiana, Massachusetts, Michigan, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. *Schoenoplectiella purshiana* var. *williamsii* is identical to the autonym in all aspects, including involcural bract divergence and the presence of a central bulge on the abaxial surface of the achene, but it lacks perianth bristles.

2. Schoenoplectiella smithii (A. Gray) Shiels & Monfils, comb. nov. Basionym: *Scirpus smithii* A. Gray, Manual (ed. 5), 563. 1867. *Schoenoplectus smithii* (A. Gray) Soják, Čas. Nár. Mus., Odd. Přír. 141: 62. 1972, non *Schoenoplectus smithii* (A. Gray) J. Raynal, Adansonia, n.s., 16(4): 530. 1977, nom. illeg. TYPE: U.S.A. New Jersey: in tidal mud on NJ shore of the Delaware below Red Bank opposite River Schuylkill, July 1865, *C. E. Smith s.n.* (holotype, GH-00028048; isotype, PH-0002818 photo).

2a. Schoenoplectiella smithii (A. Gray) Shiels & Monfils var. **smithii.**

Habitat and distribution. The autonymic variety of *Schoenoplectiella smithii* is found in coastal, freshwater tidal flats and inland sandy or muddy shores with large fluctuations in water levels. The taxon has been reported from Ontario and Quebec in Canada as well as from the eastern United States, from the states of Connecticut, Delaware, Indiana, Massachusetts, Michigan, Minnesota, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. The type collections of *Scirpus smithii*, GH-00028048 and PH-0002818, are assigned holotype and isotype status, respectively. There is some ambiguity with the 1867 protologue in the details that are limited to: "July," C. E. Smith, "in tidal mud," and "Delaware Bay." The holotype and isotype agree on collector, collection site, and "July," and are otherwise compatible with the protologue. A second sheet from GH (GH-00028049) was collected by C. E. Smith and looks like the holotype in many regards but does not contain a date or mention of July and was collected at a nearby but different site ("on the shores of the Schuylkill at Penrose Ferry") from the holotype's locality. This collection would not be a duplicate and there is not enough evidence to consider it a syntype.

Schoenoplectiella smithii is an herbaceous annual with tufted culms displaying a pseudolateral inflorescence and an erect (very rarely divergent) involcural bract. The inflorescence consists of one to 15 sessile spikelets. Flowers contain a perianth of one to six bristles much shorter than to two times longer than the achene or are missing perianth bristles; if present, each bristle is slender throughout. Achenes have convex to slightly angled abaxial surfaces with no central bulge (Smith, 2002). *Schoenoplectiella smithii* has three varieties designated morphologically by presence, number, and character of perianth bristles: *S. smithii* var. *smithii*, *S. smithii* var. *leviseta*, and *S. smithii* var. *setosa*. *Schoenoplectiella smithii* var. *smithii* does not contain perianth bristles or, if present, the bristles are rudimentary.

2b. Schoenoplectiella smithii var. **leviseta** (Fassett) Shiels & Monfils, comb. nov. Basionym: *Scirpus smithii* var. *levisetus* Fassett, Rhodora 23: 42. 1921. *Scirpus smithii* fo. *levisetus* (Fassett) Fernald, Rhodora 44: 479. 1942. *Schoenoplectus smithii* (A. Gray) Soják var. *levisetus* (Fassett) S. G. Sm., Novon 12(1): 108. 2002. TYPE: U.S.A. Maine. [Sagadahoc Co.], Bowdoinham and at its mouth in Merrymeeting Bay, tidal flats of the Cathance River, 31 Aug. 1920, *N. C. Fassett 26* (holotype, GH-00028050; isotype, NY-00051663 photo).

Habitat and distribution. *Schoenoplectiella smithii* var. *leviseta* is found in coastal, freshwater tidal flats or rocky shores of rivers in eastern Canada, collected from New Brunswick and Quebec, and in the northeastern United States from Connecticut, Massachusetts, Maine, and Virginia, where it is presumed to be extirpated (Smith & Hayasaka, 2002).

Discussion. Type material of *Scirpus smithii* var. *levisetus* agrees on collection number and collection date, which falls within the date range listed in the protologue, and are maintained here despite no collection number provided in the protologue. The sheets GH-00028050 annotated as "Type" and NY-00051663 noted as "CoType" are interpreted as holotype and isotype, respectively.

Schoenoplectiella smithii var. *leviseta* is identical to the autonym in all aspects, including an erect involcural bract and achene shape, except for the presence of perianth bristles. The perianth contains from one to four slender bristles that are much shorter than to equaling the achene and contain barbs at the tips of the bristles or are otherwise lacking barbs (Strong, 1994). *Schoenoplectiella smithii* var. *leviseta* bristles will be more than one fourth of the achene height, while *Schoenoplectiella smithii* var. *smithii* bristles, if present, will not reach past one fourth of the achene's height and *S. smithii* var.

setosa bristles will exceed the achene's height and contain barbs throughout.

2c. Schoenoplectiella smithii var. **setosa** (Fernald) Shiels & Monfils, comb. nov. Basionym: *Scirpus smithii* var. *setosus* Fernald, Rhodora 3: 252. 1901. *Scirpus smithii* A. Gray fo. *setosus* (Fernald) Fernald, Rhodora 44: 479. 1942. *Schoenoplectus smithii* (A. Gray) Soják var. *setosus* (Fernald) S. G. Sm. Novon 12(1): 107. 2002. TYPE: U.S.A. Illinois: Augusta, 1845, *S. B. Mead s.n.* (holotype, GH-00028051; isotypes, NY-00051662 photo, PH-00022819 photo).

Habitat and distribution. *Schoenoplectiella smithii* var. *setosa* is found in freshwater, sandy, or muddy shores with relatively stable water levels, floating mats, and bogs. The variety occurs in Canada from Ontario and Quebec and in the eastern United States from Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Carolina, Ohio, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. *Schoenoplectiella smithii* var. *setosa* is identical to the autonym in all aspects, including an erect involcural bract and achene shape, except for the presence of perianth bristles. This taxon has slender perianth bristles like *S. smithii* var. *leviseta* but differs in containing four to six perianth bristles equaling to twice as long as the achene and each bristle contains barbs throughout (Strong, 1994).

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A New Combination in *Senna* (Leguminosae, Caesalpinioideae) from the Department of Valle del Cauca, Colombia

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ABSTRACT. A new combination, *Senna tocotana* (Rose ex Britton & Killip) Silverst., is proposed for *Chamaefistula tocotana* Rose ex Britton & Killip, the latter name previously placed in synonymy of *S. viminea* (L.) H. S. Irwin & Barneby. The Colombian species *S. tocotana* is not conspecific with the Jamaican species *S. viminea*. They differ notably in the size and shape of the fruits and in the arrangement of seeds; the fruits of *S. viminea* are shorter and broader than in *S. tocotana*, and the seeds are biseriate (in two rows) versus uniseriate in *S. tocotana*.

RESUMEN. Una nueva combinación, *Senna tocotana* (Rose ex Britton & Killip) Silverst., se propone para *Chamaefistula tocotana* Rose ex Britton & Killip, la cual estaba colocada en la sinonimia de *S. viminea* (L.) H. S. Irwin & Barneby. La especie colombiana *S. tocotana* no pertenece a la misma especie como la especie jamaicana *S. viminea*. Ellas difieren notablemente en el tamaño y la forma de los frutos y en la ordenación de las semillas; los frutos de *S. viminea* son más cortos y más anchos que en *S. tocotana*, y las semillas son biseriadas (en dos filas), versus uniseriadas en *S. tocotana*.

Key words: Caesalpinioideae, *Chamaefistula*, Colombia, Leguminosae, *Senna*, Valle del Cauca.

The genus *Senna* Mill. (Leguminosae, Caesalpinioideae) includes 350 species, of which 80% are found in the New World (Marazzi et al., 2006). The New World species were revised by Irwin and Barneby (1982), who divided the genus into six sections and 35 series. The largest of the sections is *Senna* sect. *Chamaefistula* (DC. ex Collad.) H. S. Irwin & Barneby. It is characterized by simple trichomes, ebracteolate pedicels, usually zygomorphic flowers, palmately veined sepals, and not more than seven fertile stamens, with the longest abaxial stamens parallel to the floral axis. Within the section *Chamaefistula*, the series *Bacillares* (Benth.) H. S. Irwin & Barneby is characterized by a woody, caulescent, evergreen habit, leaves with two pairs of leaflets and one or two glands on the rachis, dimorphic fertile stamens with beaked anthers, and a turgid, often pulpy fruit, with at least 50 seeds arranged transversely to the longitudinal axis of the fruit. Marazzi et al. (2006) showed that, based on three chloroplast genes, the section *Chamaefistula* was paraphyletic, although the series *Bacillares* was supported as monophyletic.

In 1986, Jorge E. Ramos-Pérez and I began a floristic inventory of the few remaining small patches of secondary tropical dry forest in the Cauca Valley. One of these remnants is an island of 12.5 ha of forest surrounded by open fields of sugar cane at the Hacienda El Medio, near La Paila in the Municipio de Zarzal. This forest is the last vestige of a large cacao plantation that was abandoned in the 1930s. Here, we encountered an unidentified species of *Senna* (sect. *Chamaefistula*, ser. *Bacillares*), which seemed at first to be an undescribed taxon. Later, I examined specimens at COL and VALLE that were identified by E. P. Killip (probably in the 1940s) as *Chamaefistula tocotana* Rose ex Britton & Killip; these specimens were collected between 1944 and 1946 by José Cuatrecasas-Arumí (*J. Cuatrecasas 18393*, *19565*, *22019*) from the eastern slope of the Cordillera Occidental of the Andes in the department of Valle del Cauca, Colombia, between 1680 and 2250 m. The collections had been filed under *S. viminea* (L.) H. S. Irwin & Barneby, following the synoptic treatment by Irwin and Barneby (1982), who placed *C. tocotana* in the synonymy of *S. viminea* without making the new combination in *Senna*.

The lectotype of *Senna viminea* (*P. Browne s.n.*, LINN-528.6, collected in Jamaica) was designated by Fawcett and Rendle (1920: 102). I have seen images of the lectotype and five non-type specimens of *S. viminea* from Jamaica, and of the type collection of *Chamaefistula tocotana* (*H. Pittier 720*, holotype, US; isotype, NY), collected in Colombia. Data on labels of some of the specimens examined indicate that *S. viminea* is a vine, whereas *C. tocotana* is a shrub or small tree.

In the material examined, the fruits of the specimens of *Senna viminea* from Jamaica differ to such a degree from those of the type collection of

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Figure 1. Comparison of fruits of two species of *Senna*. —A. *S. viminea* L. (*N. L. Britton 2718*, NY, not a type specimen). —B. Isotype specimen of *S. tocotana* (Rose ex Britton & Killip) Silverst. (*H. Pittier 720*, NY).

Chamaefistula tocotana that they cannot belong to the same species (Fig. 1). The largest fruits of *S. viminea* are relatively short and broad. Measurements of eight fruits from four Jamaican specimens of *S. viminea* (*C. L. G. Bertero s.n.*, MO; *N. L. Britton 2718*, NY; *A. S. Hitchcock s.n.*, MO; *J. W. Walker 297*, US) are 1.9–5.3 × 0.4–2.4 cm (1.5–4.8× longer than wide). In contrast, the largest fruit (immature) of the holotype (*H. Pittier 720*, US) of *C. tocotana* is elongate and narrow, 9.5 × 0.5 cm (19× longer than wide).

Some Venezuelan specimens were provisionally determined by Irwin and Barneby (1982), following

Bentham, as *Senna viminea*. I have seen images of one of these specimens (*A. Fendler s.n.*, MO). Irwin and Barneby (1982) noted that these specimens lack fruits and thus cannot be definitively determined as *S. viminea*. The status of these Venezuelan specimens is uncertain, and I cannot include them in *Chamaefistula tocotana*.

The collections from Hacienda El Medio (*Silverstone-Sopkin et al. 2547* and *Silverstone-Sopkin & Arroyo-Valencia 5442*, Fig. 2) resemble the Cuatrecasas specimens of *Chamaefistula tocotana* in key diagnostic characters (leaflet number, size, and shape; sepal size, venation, and pubescence; seven subequal fertile anthers; fruit size and shape). Petal size for *C. tocotana* is similar: 12–12.5 mm in El Medio specimens and 12 mm in the protologue (Britton & Killip, 1936). S. F. Smith (pers. comm.) measured the longest petal in the holotype of *C. tocotana* as 14 mm, and the petals in the Cuatrecasas specimens at VALLE vary from 11 to 15 mm long; the difference in petal size between the El Medio and *C. tocotana* specimens is small and not consistent. The fruits of the El Medio specimens are similar to those of the type collection of *C. tocotana* in shape; their seeds are uniseriate (in one row), unlike the biseriate seeds of *S. viminea* as described by Irwin and Barneby (1982).

After examining the aforementioned specimens and images, I concluded that the unidentified species of *Senna* collected at the Hacienda El Medio is not a new species; it is conspecific with the type of *Chamaefistula tocotana*. Furthermore, *C. tocotana* is not conspecific with *S. viminea*. Therefore, I propose the following new combination.

Senna tocotana (Rose ex Britton & Killip) Silverst., comb. nov. Basionym: *Chamaefistula tocotana* Rose ex Britton & Killip, Ann. New York Acad. Sci. 35: 174. 1936. TYPE: Colombia. Valle del Cauca: Cuesta de Tocotá, rd. from Buenaventura to Cali, Dec. 1905, *H. Pittier 720* (holotype, US; isotype, NY). Figures 1B, 2.

[This description is based on all specimens examined, except where otherwise noted.] Shrubs or small trees, ca. 2–4 m tall; young branches quadrangular, glabrous. Leaves with stipules filiform, 13 mm (in El Medio specimens), caducous; petioles 1.3–5.4 cm, glabrous; rachises 1–4.9 cm, glabrous, gland 1, on adaxial surface of rachis between proximal pair of leaflets, black, sessile, erect, conical, 3.5 mm long, terminal appendage of rachis very slender and inconspicuous, 1 mm long; leaflets in 2 pairs, petiolules 2 mm, with black spiculiform trichomes at adaxial base; blades of distal pair of leaflets larger than those of proximal pair, 6.8–17.5 × 2.7–7.4 cm, usually elliptical, sometimes ovate or lanceolate, apex acuminate, base rounded to obtuse and unequal, major lateral veins in 9 to 14 pairs; blades of proximal pair of leaflets 2.9–11.1 × 1.6–5.9 cm, ovate, apex acuminate, base rounded to obtuse and unequal, major lateral veins in 7 to 11(to 14) pairs; both pairs of leaflets with margin revolute, almost glabrous except for a few small appressed trichomes on major veins of both surfaces or only below, border usually ciliolate. Inflorescence an axillary raceme, sometimes crowded at tip of branch in axils of very young leaves with glands and stipules but without leaflets, thus sometimes appearing paniculate, not surpassing mature leaves; peduncle 1.2–7.2 cm, rachis 0.4–8 cm, both puberulent, with whitish trichomes; bracts 2.5–4 mm, concave on adaxial surface, lanceolate, apiculate, glabrescent except at base, margin ciliolate except at base. Flowers 4 to 35 per raceme; pedicels 4–22 mm, puberulent; sepals 3–5 × 1.4–3 mm, only slightly unequal (but 1 sepal of each flower adaxially concave in El Medio specimens), ovate to elliptical, apex rounded, puberulent on both surfaces, with whitish trichomes, veins not prominent, green when fresh, light brown when dried; petals (dried specimens) 11–15 × 4.5–7 mm, (in alcohol, El Medio specimens) 12 × 6–7 mm, subequal, elliptical to obovate, apex rounded, pubescent on both surfaces, bright yellow when fresh; adaxial staminodes 3, 1–1.2 mm, fertile stamens 7, usually only slightly dimorphic, median stamens 4, with filaments 2 mm, puberulent, anthers (including beak 0.5 mm) 5.2 × 1.5 mm, glabrous, abaxial stamens 3, subequal, filaments 3.5 mm, anthers (including beak 1.5 mm) 4.8–5 × 1.5 mm, beaks curved and slightly bifid at tip, opening by 2 distal pores; pistil curved, 15 mm long when straightened (of which distal 4 mm is style), densely puberulent; ovules 83, 1 ovary counted (stamen and pistil measurements from El Medio specimens only, in alcohol). Fruit (not mature, El Medio specimens) 19.5–26 × 0.6–0.8 cm, cylindrical, lacking raised borders adjacent to sutures, slightly compressed between seeds, flexible, beaked (beak 4 mm), sparsely puberulent (mostly on sutures), not papillate, shiny green when fresh, dehiscence unknown (perhaps indehiscent); seeds uniseriate, broadside to septa, embedded in thin pulp.

Distribution and habitat. *Senna tocotana* is known only from Colombia. It has been collected between 950 and 2250 m, in cloud forest on the western and eastern slopes of the Cordillera Occidental and the western slope of the Cordillera Central, and in dry forest in the Cauca Valley. It

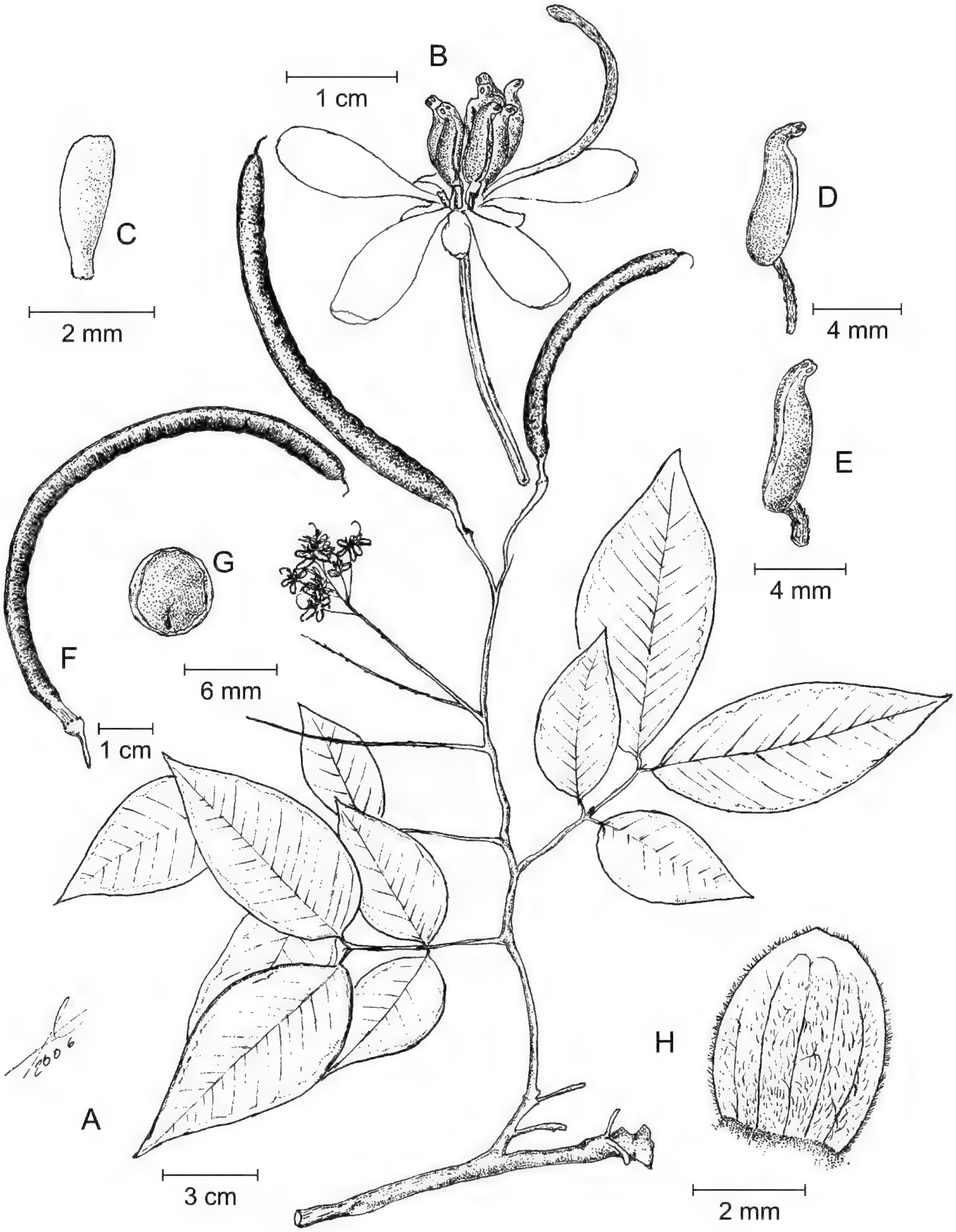

Figure 2. *Senna tocotana* (Rose ex Britton & Killip) Silverst. —A. Branch with inflorescence and infructescence. —B. Flower. —C. Adaxial staminode. —D. Fertile abaxial stamen. —E. Fertile median stamen. —F. Fruit. —G. Fruit, cross section, showing that seeds are uniseriate. —H. Sepal, abaxial view, showing that sepals are puberulent with inconspicuous veins. Drawn from *P. A. Silverstone-Sopkin & J. E. Arroyo-Valencia 5442* (CUVC), with B–H from material preserved in 70% ethanol and 5% glycerin.

should be noted that the forest in the western part of the Hacienda El Medio, although designated as tropical dry forest (based on climate) according to the Holdridge system (1967), has a flora similar to that of tropical moist forest in Panama, with only 8% of the tree species deciduous, probably because of a high water table (the Río La Paila is only 120 m from the forest, which formerly was subject to seasonal flooding).

The type locality of *Chamaefistula tocotana*, Tocotá, is a village in the municipality of Dagua, department of Valle del Cauca, 22 km by road southeast of Dagua, on the old road from Cali to Buenaventura, at 1500 m elevation, on the western slope of the Cordillera Occidental of the Andes, at 3°31′N, 76°39′W, below the pass of Las Cruces (IGAC, 1980; Paynter, 1997). Since the locality on the label of the holotype is "Cuesta [= slope, hill] de Tocotá,. . .1500–1900 m," the type may have been collected on the slope above the village of Tocotá.

Additional specimens examined. COLOMBIA. **Valle del Cauca:** Mpio. La Cumbre, vereda Chicoral, Cordillera Occidental, Res. Alto Bitaco, *T. Cano 39* (CUVC); [Mpio. Cali], Cordillera Occidental, vertiente oriental, hoya del río Cali, vertiente derecha, Quebradahonda, arriba de La Glorieta, camino a Miralindo, *J. Cuatrecasas 18393* (COL, VALLE); [Mpio. La Cumbre], Cordillera Occidental, La Cumbre, *J. Cuatrecasas 19565* (VALLE); [Mpio. Cali], Cordillera Occidental, vertiente oriental, hoya del río Cali, río Pichindé, en Los Cárpatos, *J. Cuatrecasas 22019* (COL, VALLE); Mpio. Yotoco, correg. Jiguales, vereda Jardín, finca Milán, *W. Devia 897* (COL); hoya del río Cali, El Saladito, *J. M. Duque-Jaramillo 1677* (VALLE); Mpio. Palmira, Cordillera Central, vertiente occidental, cuenca superior del río Nima, margen izquierda de quebrada Los Añascos, cerca a Tenjo, *A. Roa 137* (CUVC); Mpio. Zarzal, Hacienda El Medio, valle geográfico del río Cauca, al W de carr. Panamericana, entre La Paila y Zarzal, 4°20′07″N, 76°04′52″W, *P. A. Silverstone-Sopkin, N. Paz & R. T. González 2547* (CUVC, NY), *P. A. Silverstone-Sopkin & J. E. Arroyo-Valencia 5442* (COL, CUVC, HUA, NY).

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Studies in Andean *Ocotea* (Lauraceae). I. Species with Hermaphrodite Flowers and Fistulose Twigs Occurring Above 1000 m Altitude

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Abstract. A key to and descriptions of the seven species of *Ocotea* Aubl. (Lauraceae) with bisexual flowers and fistulose twigs occurring in the Andes are presented. Of the seven species, five are newly described: *O. beekmanii* van der Werff, *O. cuatrecasasii* van der Werff, both from Colombia, *O. fistulosa* van der Werff from Ecuador, *O. magnifrons* van der Werff described from Ecuador and also in Colombia, and *O. obovatifolia* van der Werff from Ecuador.

Key words: Andes, Colombia, Ecuador, IUCN Red List, Lauraceae, *Ocotea*.

The genus *Ocotea* Aubl. is without doubt the largest genus of Lauraceae in the Neotropics. Rohwer (1993) gave a total of ca. 300 species. However, new species have been published regularly since 1993, and van der Werff (2011) estimated that the number of species would be between 350 and 400. Species of *Ocotea* occur from Mexico to Argentina and are most common in wet, evergreen forests from sea level to the tree line. In northern Ecuador, for example, *Ocotea* species are an important component of forests at 3200 m altitude. The American species were last revised by Mez (1889); however, the large number of species makes a new revision unlikely. There have been regional treatments, such as a synopsis for the Flora MesoAmericana region (van der Werff, 2002a), and contributions to regional floras, such as for the *Flora of the Venezuelan Guayana* (van der Werff, 1999), the *Ocotea* species from the Reserva Florestal Ducke near Manaus (van der Werff & Vicentini, 2000), the *Guide to the Vascular Plants of Central French Guiana* (van der Werff, 2002b), and the *Flora del Rio Cenepa, Amazonas, Peru* (van der Werff, 2010).

Ocotea is characterized by flowers with six equal tepals and nine 4-locular stamens, the locelli arranged in two superposed pairs, a lack of staminodia, or when present, the staminodia stipitiform, and the fruit seated in a shallow or deep cupule. Flowers can be unisexual or perfect. Rohwer (1986) gave an overview of the genus, including keys to species groups and species, based largely on a study of type specimens. This publication has greatly facilitated subsequent studies with the informal description of a large number of species groups. Rohwer's *O. aciphylla* (Nees) Mez species group is represented by several species in the Andean region. It is characterized by hermaphrodite flowers, densely pubescent inner surfaces of the tepals, pubescent staminodia, a deep receptacle, and a deep cupule (Rohwer, 1986: 115). Additional characters include deeply canaliculate petioles, lack of domatia, and basal secondary veins positioned closer together than the distal ones (van der Werff, pers. obs.). Chanderbali et al. (2001) published a large phylogeny of Neotropical Lauraceae and showed that *Ocotea* as traditionally circumscribed is almost certainly polyphyletic. Five distinct clades were recognized among the Neotropical species, but the number of South American species investigated was small. However, before relationships between the species can be studied in a meaningful way, it will be necessary to describe all the species comprehensively. Making the species known is the aim of this and subsequent publications.

Lauraceae in the Andean region are poorly known in comparison to Lauraceae in the South American lowlands. Based on the earliest collections by Ruiz and Pavon, Mutis, and Humboldt and Bonpland, a relatively small number of species (ca. 18) currently placed in *Ocotea* were described. Based on collections by Hartweg, Stuebel, Purdie, Karsten, and Linden, a few more species were described, but the total number of *Ocotea* species known from the Andes remained low. Collections from the early 20th century by Sodiro and especially Weberbauer yielded many additional species described by Mez (1904, 1906) and later by Schmidt (1933). In the second half of the 20th century, Cuatrecasas made excellent collections in Colombia, but his Lauraceae specimens have not yet been comprehensively studied. In the latter part of the last century, several institutions and particularly the Missouri Botanical Garden initiated intensive collecting programs in the Andean region, especially in Ecuador and Peru. From this, several *Ocotea* species have been described (van der Werff, 1991, 1994, 2003). However, the number of unidentified collections remains large and includes

a number of undescribed species. In this publication, a first step will be made toward describing the Andean species of *Ocotea*, restricted to those occurring above 1000 m altitude in the Andes of Venezuela, Colombia, Ecuador, Peru, and Bolivia. Descriptions of all the species and keys to species will be presented. In the case of known species represented by many collections, only selected specimens will be cited. Additional collections can be found on Tropicos (<http://www.tropicos.org>), the database of the Missouri Botanical Garden. The species will be divided into groups based on readily observable morphological characters. No attempt has been made to present monophyletic groups at this time. Once species have been described, it will be possible to study their relationships, but this cannot be done while so many species are unknown. Even though a substantial number of new species will be published in this and subsequent publications, additional new species can still be expected. Our knowledge of the species in Colombia is especially poor due to civil unrest in that country and the difficulty of sending botanical specimens abroad. Experience in better-explored Ecuador and Peru shows that once collecting starts in any undisturbed area with montane forest, new species of *Ocotea* are encountered.

In this contribution, seven species of *Ocotea* with bisexual flowers and fistulose stems are presented. Although sometimes the fistulose stems are not conspicuous, all these species have thick twigs that abruptly narrow at the tip (in species with solid stems, the twigs narrow gradually toward the tip) and small pores or longitudinal slits in the stems and/or inflorescences through which the ants can enter or exit the hollow stems. Specimen labels often mention the presence of ants in the hollow twigs, but there are only two references to the presence of aggressive ants, both in lowland collections of *O. javitensis* (Kunth) Pittier. In *O. fistulosa* van der Werff, the ants do not leave the hollow twigs after they are cut, and the twigs are lined on the inside with a black layer, suggesting that the ants are cultivating a fungus (van der Werff, pers. obs.).

IUCN Red List category. Most of the species described here are known from few collections. They could be assessed as threatened or vulnerable based on the IUCN (2001) criteria because of the general trend toward deforestation in the Andean region. However, because no specific threats are known, I prefer to assess them as Data Deficient (DD) with the exception of *Ocotea javitensis*, which I assess as Least Concern (LC).

KEY TO ANDEAN SPECIES OF *OCOTEA* WITH BISEXUAL FLOWERS AND FISTULOSE TWIGS OCCURRING ABOVE 1000 M ALTITUDE

1a. Lower leaf surface completely covered by the indument 2
1b. Lower leaf surface glabrous to moderately appressed pubescent, the surface at least partly visible 3
2a. Midrib and secondary veins impressed on the upper leaf surface and prominently raised on the lower surface; petiole flat above .... *O. cuatrecasasii*
2b. Major veins immersed on the upper leaf surface and not or weakly raised on the lower surface; petiole strongly canaliculate ..... *O. beekmanii*
3a. Leaf base inrolled and decurrent on the petiole, petiole winged to the base ..... *O. fistulosa*
3b. Leaf base flat, not decurrent on the petiole or if somewhat decurrent and inrolled, basal 1–2 cm of the petiole free, not winged 4
4a. Lower surface of leaves glaucous ..... *O. amplissima*
4b. Lower surface of leaves green, not glaucous 5
5a. Lateral veins loop-connected in the distal 1/2 of the lamina; fronds broadly elliptic, large, 25–55 × 11–25 cm, tips shortly acuminate or acuminate ..... *O. magnifrons*
5b. Lateral veins free, not loop-connected; fronds elliptic to obovate, to 35 × 15 cm, tips acute or obtuse 6
6a. Twigs angular; leaf apices obtuse; cupule plate-like, undulate, with a single margin .... *O. obovatifolia*
6b. Twigs terete; leaf apices acute or acuminate; cupule cup- or bowl-shaped, not undulate, often weakly double-margined ..... *O. javitensis*

I. Ocotea Aubl., Hist. Pl. Guiane 2: 780–781, tab. 310. 1775. TYPE: *Ocotea guianensis* Aubl.

1. Ocotea amplissima Mez, Repert. Spec. Nov. Regni Veg. 3: 68. 1906. TYPE: Peru. Huanuco: Huamalies, mtns. SW of Monzon, 2000–2500 m, 8 Aug. 1903, *Weberbauer 3550* (holotype, B; isotype, G not seen).

Shrubs, 3 m, or trees, 22 m; twigs angular, hollow, 10–12 mm diam., densely and minutely appressed pubescent when young, becoming glabrous with age; terminal buds densely pubescent. Leaves 18–30 × 6.5–12 cm, alternate, elliptic to elliptic-ovate, stiffly chartaceous, the base flat, acute to obtuse, the distal 1/2 gradually narrowed, the apex acute, upper surface glabrous, the lower surface glaucous, glabrous, but with some appressed hairs on the midrib below; venation immersed on the upper surface; midrib and secondary veins raised on the lower surface, tertiary veins immersed; domatia absent; secondary veins in 8 to 11 pairs; petioles 1–1.7 cm, strongly canaliculate, not winged. Inflorescences 8–16 cm, densely flowered, paniculate-cymose, densely appressed pubescent. Flowers green, 2.5 mm diam. (not quite mature), moderately pubescent on the outer surface; immature tepals with a few hairs at the base, otherwise

glabrous, on the inner surface; stamens 9, all 4-celled; staminodia stipitiform, densely pubescent; pistil glabrous, receptacle deep, glabrous inside. Immature fruit 1 cm diam., largely enclosed in the cupule.

Discussion. The type collection of *Ocotea amplissima* is a 3 m shrub that has inflorescences with many buds but lacks open flowers. The second collection (a 22 m tree) also has buds and immature fruits. Therefore, no measurements of the floral parts are given in the description above. The species is well defined by its large, glaucous leaves and thick, fistulose twigs. The specific epithet refers to the large, branched inflorescences. Rohwer (1986) included this species in his *O. aciphylla* species group. The two collections cited for *O. amplissima* were made in central Peru between 2000 and 2500 m altitude.

Additional specimen seen. PERU. **Pasco:** Oxapampa, Distr. Huancabamba, ca. de la Laguna San Daniel, *Monteagudo et al. 9311* (MO).

2. Ocotea beekmanii van der Werff, sp. nov. TYPE. Colombia. Antioquia: Mpio. Urrao, Parque Nac. Nat. "Las Orquídeas," 06°32′N, 76°19′W, 1450 m, 1 Dec. 1993, *A. Cogollo, A. Duque, F. Giraldo, W. Rodriguez & E. Alvarez 7633* (holotype, MO-04982546; isotype, NY). Figure 1.

Ocoteae amplissimae Mez similis, sed ab ea receptaculo intus pubescenti et foliis latioribus abaxialiter dense rufo-pubescentibus (nec glaucis trichomatibus adpressis praeditis) recedit.

Trees, to 17 m; twigs angular, hollow, (5–)7–11 mm diam., densely to moderately appressed pubescent; terminal buds densely and minutely appressed pubescent. Leaves 18–34 × 7.5–15 cm, alternate, elliptic to broadly elliptic, firmly chartaceous, the base obtuse to rounded, rarely acute, sometimes decurrent on the petiole, the apex obtuse to acuminate, the acumen to 2 cm, but often broken off, the upper blade surface glabrous, the lower surface minutely and densely reddish brown pubescent, the hairs short and appressed, the indument becoming sparser with age; venation immersed on the upper surface; midrib raised, secondary veins weakly raised and tertiary venation immersed on the lower surface; domatia absent; secondary veins 6 to 8 on each side of the leaf; petioles 2–4 cm, canaliculate, moderately to sparsely appressed pubescent. Inflorescences ca. 10 cm, paniculate-cymose, moderately to densely pubescent, the hairs appressed or ascending, in the axils of leaves. Flowers yellowish, ca. 5 mm diam., pedicels 2 mm; tepals 2 mm, densely pubescent on the outer surface, sparsely pubescent on the inner surface, spreading at anthesis; stamens 9, 1 mm, the filaments pubescent, the anthers glabrous, 4-celled, glands present at the base of the inner stamens, globose, ca. 0.5 mm; staminodia present, 0.5 mm, pubescent; pistil glabrous, 2.5 mm, receptacle deep, densely pubescent inside. Fruit ellipsoid, 4 × 2.3 cm, cupule 1.6 cm high, 2.6 cm diam., deeply cup-shaped, glabrous, faintly double-margined.

Discussion. *Ocotea beekmanii* is closely related to *O. amplissima*, and both belong to the *O. aciphylla* species group. It differs from *O. amplissima* in having a densely pubescent inner surface of the receptacle (vs. glabrous in *O. amplissima*) and in the reddish brown indument on the lower leaf surface (vs. lower leaf surface glaucous and sparsely appressed pubescent in *O. amplissima*). The leaf shape is also different: *O. beekmanii* has broader leaves that are often acuminate compared to *O. amplissima*, which has leaves that gradually taper into an acute tip.

Rohwer (1986) lists two additional species of the *Ocotea aciphylla* species group with hollow twigs, *O. laticostata* C. K. Allen and *O. javitensis*. *Ocotea laticostata* is known from Venezuelan Guayana and differs in having the margins of the leaves revolute, the lower leaf surfaces glabrous or nearly so, and the tepals sparsely pubescent on the outer surface. *Ocotea javitensis* lacks the reddish brown pubescence on the lower leaf surface; its leaves are glabrous or bear few appressed hairs.

Ocotea beekmanii has been collected several times during an inventory of a permanent plot (Parcela G) in the Parque Nacional Natural "Las Orquídeas" in Mpio. Urrao, Antioquia, Colombia, at an altitude of 1450 m. Most of these collections are sterile. The type collection has a small inflorescence, and it is possible that additional collections will show that inflorescences can be larger. Although the fruits are quite large, they are described by the collectors as immature and green. Collections have been previously identified as *O. aciphylla*, and duplicates may have been distributed under that name.

Ocotea beekmanii is dedicated to the late E. M. Beekman (1939–2008), linguist, poet, and translator of Rumphius's *Herbarium Amboinense*.

Paratypes. COLOMBIA. **Antioquia:** Mpio. Urrao, Parque Nac. Nat. "Las Orquídeas," 06°32′N, 76°19′W, 1450 m, 15–20 Oct. 1993, *A. Cogollo, A. Duque, F. Giraldo, W. Rodriguez & J. Velez 6891, 6898, 6935, 6938, 6990, 7212, 7968* (all at MO), 14–17 Aug. 1993, *A. Cogollo, A. Duque, F. Giraldo, W. Rodriguez, W. Ramirez & E. Alvarez 6430, 6432, 6436, 6481, 6488, 6510, 6514, 6555, 6560, 6571, 6575* (all at MO), 11–26 Nov. 1993, *A. Cogollo, A. Duque,*

Figure 1. *Ocotea beekmanii* van der Werff (*Cogollo et al. 7245*, MO).

F. Giraldo, W. Rodriguez & E. Alvarez 7245 (MO, NY), *7254* (MO), *7255* (MO), *7305* (MO), *7461* (MO).

3. Ocotea cuatrecasasii van der Werff, sp. nov. TYPE: Colombia. Dpto. del Valle: Cordillera Occidental, Hoya del Rio Alban, Quebrada Robada, Alto Bonito, 1800–1900 m, 20 Oct. 1946, *J. Cuatrecasas 22355* (holotype, US-2267151; isotypes, P, U-362766 [fls.], U-362767 [st.]). Figure 2.

Figure 2. Holotype of *Ocotea cuatrecasasii* van der Werff (*Cuatrecasas 22355*, US).

A speciebus ramulis fistulosis ac foliorum venis majoribus impressis praeditis, petiolis adaxialiter applanatis et tepalis patentibus recedit.

Large trees, to 18 m or more; twigs hollow, with a small lumen, or solid, 7–8 mm diam., brown tomentulose or puberulous, the indument covering the surface completely, but paler and wearing off on older twigs; terminal buds densely pubescent. Leaves 11–18 × 6–10 cm, alternate, elliptic to broadly elliptic, coriaceous, the base cuneate to

acute, the apex obtuse or bluntly acute, the margin slightly revolute, the lower surface densely and minutely tomentulose, in sicco brown with a bluish tinge, the upper surface minutely and sparsely tomentulose, especially near the base, the hairs falling off with age and the upper surface becoming lustrous; midrib and lateral veins impressed, tertiary venation immersed on the upper surface; midrib and lateral veins prominently raised, tertiary venation slightly raised and scalariform on the lower surface; domatia absent; lateral veins 8 to 10 on each side of the leaf; petioles 9–12 mm, flat above, minutely tomentulose. Inflorescences mostly in the axils of bracts at the base of seasonal growth, to 22 cm, paniculate-cymose, densely brown tomentulose. Flowers yellowish, 5–6 mm diam.; tepals 6, spreading, 2–2.5 × 2 mm, the tip rounded, densely pubescent on the inner surface, tepals and receptacle densely brown pubescent outside; stamens 9, all 4-locular, the outer 6 ca. 1 mm, the glabrous filament 1/3 as long as the anther, the anther bent toward the center of the flower, inner stamens 1.5 mm, erect, glands present at the base of the inner stamens; staminodia absent; pistil 2.5 mm, glabrous, the style 0.6 mm, receptacle cup-shaped, glabrous inside. Fruit and cupule not known.

Discussion. Among the *Ocotea* species with fistulose twigs, *O. cuatrecasasii* stands apart by the impressed major veins on the upper leaf surface and the strongly raised veins on the lower leaf surface. It differs from taxa in the *O. aciphylla* species group in having flat (not canaliculate) petioles, impressed veins, an absence of staminodia, and spreading (not erect or half-erect) tepals. It is probably closely related to three other undescribed Andean species with impressed major veins, flat petioles, and spreading tepals. These undescribed species (with solid stems) are represented by more collections and are probably gynodioecious; plants can have either bisexual or pistillate flowers. It is likely that *O. cuatrecasasii* is also gynodioecious; the single flowering collection has bisexual flowers.

The isotype of *Ocotea cuatrecasasii* (*J. Cuatrecasas 22355*, P) has not only fistulose twigs, but also fistulose inflorescences with small pores through which the ants can enter or leave. The paratype, *Vargas 6084* (MO), has a solid, thick stem, but with slits, which give access to the core of the stem.

Ocotea cuatrecasasii is named after J. Cuatrecasas (1903–1996), eminent botanist, whose collections have added significantly to our knowledge of the Colombian flora.

Ocotea cuatrecasasii is known from two collections from the Cordillera Occidental in Colombia growing between 1800 and 2300 m. The single flowering collection was made in October and represents the holotype.

Paratype. COLOMBIA. **Risaralda:** Mpio. de Santuario, Reserva Planes de San Rafael, 2000–2300 m, May 1999, *W. Vargas 6084* (MO).

4. Ocotea fistulosa van der Werff, sp. nov. TYPE: Ecuador. Carchi: in secondary cloud forest above Maldonado, 31 July 1989, 2400 m, *H. van der Werff & E. Gudiño 10800* (holotype, MO-6327519 [fls.], MO-6327520 [frs.]; isotypes, B, COL, F, HBG, K, MA, NY, QCA, QCNE, US). Figures 3, 4.

Ocoteae amplissimae Mez affinis, sed ab ea basibus foliorum decurrentibus revolutisque diversa est.

Trees, to 16 m; twigs angular, hollow, thick, 10–12 mm diam., moderately to densely appressed gray-pubescent; terminal buds densely appressed pubescent. Leaves 33–47 × 12–19 cm, alternate, elliptic, firmly chartaceous, toward the base inrolled and decurrent on the petiole, the apex obtuse or somewhat acute, the upper surface sparsely appressed pubescent, becoming glabrous with age, lower surface moderately to densely appressed pubescent; venation immersed on the upper surface; midrib and secondary veins raised, tertiary veins immersed on the lower surface; domatia absent; lateral veins 10 to 14 on each side of the leaf; petioles ca. 1.5 cm, canaliculate, with decurrent leaf margins to the base. Inflorescences 15–30 cm, densely flowered, paniculate-cymose, in the axils of leaves, to 7 mm diam. at the base, angular, hollow and moderately pubescent near the base, densely pubescent distally. Flowers green or yellowish green, 4–5 mm diam., pedicels 2–3 mm; tepals 6, ca. 2 mm, densely pubescent outside, sparsely pubescent on the inner surface, spreading at anthesis; stamens 9, all 4-celled, ca. 0.8 mm, the anthers glabrous, the short filaments with some scattered hairs, stamens of third whorl with 2 globose glands at the base; staminodia present, stipitiform, ca. 0.5 mm; pistil and inside of the receptacle glabrous. Immature fruit 2.2 × 1.2 cm, ellipsoid, the cupule bowl-shaped, 1.5 cm diam., 0.8 cm high, the tepals persisting as weak triangular teeth.

Discussion. *Ocotea fistulosa* can be confused with *O. obovatifolia* van der Werff but differs in its denser pubescence on leaves, inflorescences, and flowers, its shorter pedicels (2–3 mm vs. 4–5 mm), and the elliptic (vs. obovate or obovate-elliptic) leaves.

Ocotea fistulosa resembles *O. amplissima* in its large leaves, thick, hollow twigs, and densely flowered inflorescences. However, its decurrent and inrolled leaf

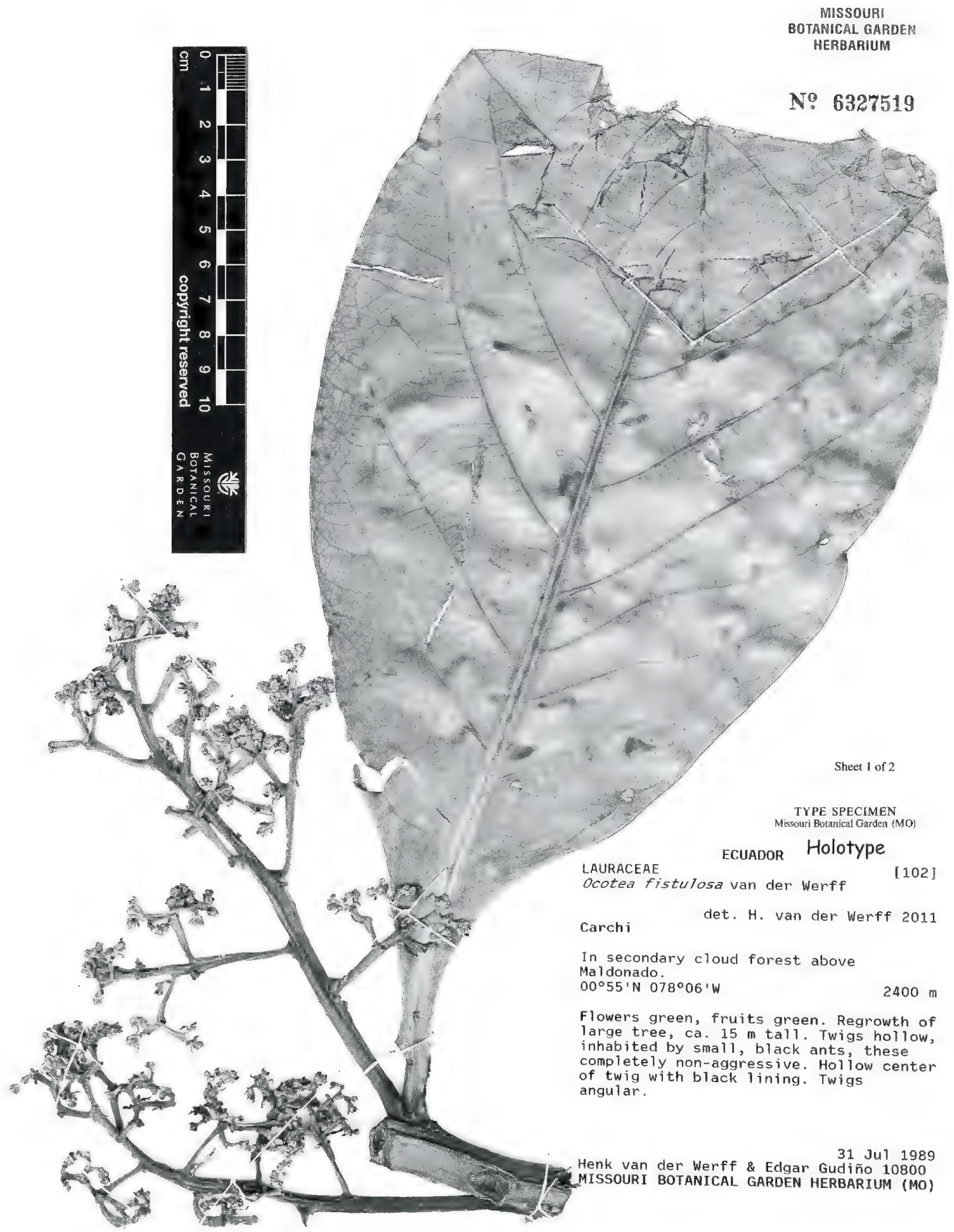

Figure 3. Holotype of *Ocotea fistulosa* van der Werff (flowering sheet; *van der Werff & Gundiño 10800*, MO-6327519).

bases make it amply distinct. The inside of the hollow twigs is covered with a black lining and is inhabited by small, non-aggressive ants (van der Werff, pers. obs.). *Ocotea fistulosa* is known from two flowering collections made in northern Ecuador at ca. 2400 m elevation in July and January (from the type *van der Werff & Gudiño 10800* and paratype *Vargas et al. 4368*).

Paratype. ECUADOR. **Carchi:** Espejo, Reserva Golondrinas, 2390 m, *H. Vargas, E. Narváez, W. Torres & P. Escobar 4368* (MO).

Figure 4. Holotype of *Ocotea fistulosa* van der Werff (fruiting sheet; *van der Werff & Gundiño 10800*, MO-6327520).

5. Ocotea javitensis (Kunth) Pittier, Cat. Fl. Venez. 1: 311. 1945. Basionym: *Laurus javitensis* Kunth, Nov. Gen. Sp. [quarto ed.] 2: 169. 1817. TYPE: Venezuela, "in umbrosis sylvarum Orinocensium juxta Javitam," *Humboldt 949* (holotype, P not seen).

Trees, to 35 m; twigs terete, hollow, infrequently slightly ridged, to 5 mm diam., smooth or lenticellate,

densely and minutely pubescent, often with small pores and inhabited by ants; terminal buds densely appressed pubescent. Leaves 10–30 × 4.5–10 cm, alternate, elliptic or obovate, firmly chartaceous, pinnately veined, the base acute to obtuse, the apex acute or acuminate, the acumen to 1.5 cm, the margin flat, glabrous on both surfaces; venation immersed on the upper surface; midrib and lateral veins somewhat raised on the lower surface; domatia absent; lateral veins 7 to 12 on each side of the leaf, evenly spaced; petioles 1–2 cm, canaliculate, finely appressed pubescent to glabrous. Inflorescences 3–10 cm, paniculate-cymose or the flowers arranged in dense, short fascicles, in the axils of leaves or bracts, occasionally along leafless short shoots, sparsely to densely pubescent, the hairs appressed or erect. Flowers white or creamish white, fragrant, 2–6 mm diam., pedicels 4–6 mm, glabrous or pubescent; tepals 6, equal, 1.5–3 mm, elliptic, erect or half-erect, the outer surface glabrous to densely pubescent, inner surface glabrous to pubescent; stamens 9, all 4-locular, the outer six 1–1.5 mm, the thecae introrse, the filaments 1/2 as long as the anthers, pubescent, inner 3 stamens with the thecae extrorse, with the same dimensions as the outer stamens, 2 globose glands present at the base of the inner stamens; staminodia present, stipitate, pubescent; pistil ca. 2 mm, glabrous, the ovary 1/2 as long as the style, receptacle deep, glabrous or pubescent inside. Fruit 1.5–3 × 1.3–2 cm, cupule weakly double-margined, sometimes appearing with a single margin, shallow, bowl-shaped, 6 mm high, 10 mm wide or deeper, cup-shaped, to 1.3 × 2.3 cm.

Discussion. *Ocotea javitensis* is a variable species, best recognized by its somewhat obovate leaves, terete, fistulose twigs, erect or half-erect tepals, and cupules with a faint double margin. Specimens assigned to this species vary in floral characters: flowers can be glabrous to densely pubescent, the inside of the receptacle can be glabrous or pubescent, and the diameter of the flowers ranges from 2 to 6 mm. The cupules are also variable appearing as bowl-shaped to cup-shaped. These differences in flowers and cupules are striking, but because specimens rarely have flowers and fruits, it is not possible to correlate particular flower types with particular cupule types. Although not all specimens mentioned in the discussion below are cited among the selected specimens here, I accept them as belonging to *O. javitensis*. The specimens of *O. javitensis* with the largest flowers and pubescent receptacles have been collected in Ecuador, mostly at altitudes above 1000 m, but *Palacios 12839* (MO), from 300 m, has these characters as well. The largest cupules and fruits are found on a specimen collected at 800 m altitude in Ecuador; this specimen (*van der Werff & Palacios 10357*, MO) has densely pubescent and relatively small (2.8 mm diam.) flowers. Although some flowering specimens come from tall trees (35 m, *Hurtado 1179*, MO), others are much smaller (7 m, *Brandbyge 30422*, MO). Unfortunately, size is not correlated with flower type either: the *Brandbyge* specimen has glabrous flowers, while *van der Werff & Palacios 10357* (10 m) has densely pubescent flowers.

There is also considerable variation in inflorescence type. Some collections show the paniculate-cymose inflorescence common in Lauraceae (for instance, *Arias 07* and *Neill et al. 8116*, both at MO), but other collections have fascicles of flowers along twigs or along inflorescences (for instance, *Brandbyge 30422* and *Klug 4324*, both at MO). In the latter case, the twigs or inflorescences are conspicuously swollen and have a large cavity. *Gudiño 321* (MO) has flowers fasciculate along short shoots with pedicels to 1.1 cm. In specimens with the flowers fasciculate along the main inflorescence axis, the inflorescence axis is thick and fistulose (to 7 mm diam., *Klug 4324*), while in specimens with regular paniculate-cymose inflorescences, the inflorescence axis is only 2 mm diam. Twigs with fascicles of flowers are also thicker (to 7 mm diam., *Romoleroux 2789*, MO) and with a larger lumen than twigs without such inflorescences.

There are many collections with somewhat condensed inflorescences and not as strongly swollen twigs. Several labels (e.g., *Palacios 4139*, *10864*) mention the presence of ants in the hollow stems, and probably several species of ants inhabit the twigs. Some labels mention red ants, and others mention black ants; the ants are described as aggressive or non-aggressive. If or how the presence of ants in the hollow twigs or inflorescences induce the fasciculate flower arrangement is not known. Since it was not possible to divide the specimens in groups that differed by more than one character, it seemed better to treat all specimens as one variable species.

Similar to *Ocotea javitensis* is *O. costulata* (Nees) Mez, a widespread lowland species (Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela) with hollow, ant-inhabited twigs; it differs in its narrower leaves with a dense, minute, and appressed indument on the lower leaf surface, more acute and often inrolled leaf bases, and deeper cupules. *Ocotea costulata* is not known from the Andean region.

IUCN Red List category. Because of its wide distribution and the large number of available

collections, *Ocotea javitensis* is assessed as Least Concern (LC) based on the IUCN (2001) criteria.

Ocotea javitensis is commonly known as Roble Alcanfor (Peru, *Pariona 07*, MO), Efuina (Huitoto Indians, Peru, *Klug 2140*, MO), Quillu ajua (*Alvarado 245*, MO; *Palacios 4139*, MO, QCNE) or Ajua (Quichua, Ecuador, *Zuleta 345*, MO, QCNE), Canelo Amarillo (Ecuador), Pinchimuyo (Ecuador, *Palacios 10864*, MO, QCNE), and Eeáya (Achual Jivaro, Peru, *Lewis et al. 11157*, MO).

This species is distributed in Venezuela, Colombia, Ecuador, Peru, Brazil, and Bolivia. The single collections from Bolivia and Brazil are sterile and their identifications are tentative. *Ocotea javitensis* is found at elevations from 110 to 2000 m.

Selected specimens seen. BOLIVIA. **La Paz:** Franz Tamayo Prov., Serranía de Chepite, *Killeen 3717* (MO). BRAZIL. **Acre:** upper Río Moa near Fazenda Arizona, *Campbell et al. 8367* (MO). BRITISH GUYANA. *Schomburgk 987* (B, P not seen). COLOMBIA. **Antioquia:** rd. betw. Amalfi & Medellín, *MacDougal & Betancur 4104* (MO). ECUADOR. **Carchi:** Tulcan Canton, Reserva Indígena Awá, Rubio, *Quelal & Nastacuaz 1739* (MO). **Esmeraldas:** San Lorenzo Canton, Parroquia Alto Tambo, *Quelal, Tipaz & Grijalva 329* (MO). **Morona-Santiago:** Cordillera de Cutucú, Centro Shuar Uunsuants/Trnaskutuku, *Palacios, Jaramillo & Nicolalde 15624* (MO). **Napo:** Cantón Archidona, Faldas sur de Volcán Sumaco, *Alvarado 245* (MO). **Zamora:** campamento Miazi, *Jaramillo 14398* (MO). PERU. **Cajamarca:** Distr. Huarango, Caserío El Triunfo, *Rodriguez 1262* (MO). **Cusco:** Distr. Camanti, Cerro Camanti, *Valenzuela, Suclli, Farfán & Carazas 8619* (MO). **Pasco:** Distr. Palcazú, *Rojas, Ortiz, Castillo & Fernandez 4578* (MO). **San Martin:** Rioja–Pomacochas rd., below Venceremos, *Gentry & Smith 45141* (MO). VENEZUELA. **Merida:** above dam site on Rio Caparo, *Liesner & Gonzalez 9264* (MO).

6. Ocotea magnifrons van der Werff, sp. nov. TYPE: Ecuador. Carchi: Rio San Juan valley, 4-hr. walk below Chical, 01°02′N, 78°15′W, 1230–1250 m, 10 June 1993, *B. Boyle, A. Butler & E. Lloyd 2063* (holotype, MO-5162944). Figure 5.

Ocoteae obovatifoliae van der Werff similis, sed ab ea foliis ellipticis venatione in dimidio distali brochidodroma et ramulis puberulis trichomatibus brevissimis erectis obtectis recedit.

Trees, to 30 m; twigs angular, hollow, 4–8 mm diam., densely and minutely puberulous, individual hairs difficult to discern, but surface of twigs completely covered; terminal buds densely pubescent with a similar indument as the twigs. Leaves 25–55 × 11–25 cm, alternate, elliptic to broadly elliptic, thinly chartaceous, the base flat, acute, the apex shortly acuminate or acuminate, the upper surface glabrous, lower surface with a dense and minute indument on the midrib, the indument becoming sparser on the secondary and tertiary venation, the lamina glabrous or nearly so; venation immersed on the upper surface; venation raised on the lower surface (including tertiary and quaternary venation); domatia absent; lateral veins 10 to 12 on each side of the leaf, loop-connected in the distal 1/2; petioles 1.2–1.8 cm, canaliculate, not winged. Inflorescences 10–17 cm, paniculate-cymose, in the axils of leaves, densely and minutely pubescent as are the twigs, sometimes hollow and with a few exit holes for ants near the base. Flowers yellowish green, 2.5–3 mm diam.; tepals 6, ca. 0.8 mm, sparsely to densely puberulous on the outside, sparsely puberulous on the inside; stamens 9, all 4-celled, glabrous, 0.8 mm, the filament 1/2 as long as the anther, inner 3 stamens with 2 glands at the base; staminodia 3, minute, stipitiform, glabrous; pistil glabrous, 1.5 mm, gradually narrowed into the short style, receptacle deep, glabrous inside. Fruit ellipsoid, 2.4 × 1.2 cm, cupule funnel-shaped, 1 cm high, 1.4 cm wide, the margin entire, tepals caducous in fruiting stage.

Discussion. *Ocotea magnifrons* is characterized by its large leaves with the secondary veins loop-connected in the distal half, its hollow, ant-inhabited twigs, and the dense, minute indument on twigs, midrib, and venation of the lower leaf surface. The cupules are funnel-shaped due to the thickened fruiting pedicels. It is similar to *O. obovatifolia*, but that species has narrower, obovate leaves, an indument on the twigs consisting of short, appressed hairs, an absence of indument on the veins of the lower leaf surface, fewer secondary veins (6 to 9 on each side of the leaf) that are not loop-connected, and larger (to 4.5 cm) fruits.

The type for *Ocotea magnifrons* has small (30 cm) leaves, but mature flowers. Most other collections are sterile or fruiting and therefore not suitable as types. *Beltran 38* (MO), a specimen with typically larger leaves and flowers, has its leaves mostly damaged and is, therefore, also not a good choice for type.

Flowering specimens have been collected in February, June, and July.

Paratypes. COLOMBIA. **Nariño:** Mpio. Ricaurte, La Planada, 1800 m, *W. Vargas 1112* (MO); Mpio. Ricaurte, Reserva Natural La Planada, 1800 m, *W. Beltran 38* (MO). ECUADOR. **Carchi:** Rio San Juan Valley, 4-hr. walk below Chical, 1230–1250 m, *B. Boyle, A. Butler & E. Lloyd 2009, 2025, 2091* (all at MO); Cerro Golondrinas in upper Rio Blanco Valley, 1750–1800 m, *B. Boyle, P. O'Hara & A. Tynberg 1519* (MO); Rio Blanco drainage above Chical, 1300–1500 m, *A. Gentry & G. Shupp 26553, 26566* (both at MO).

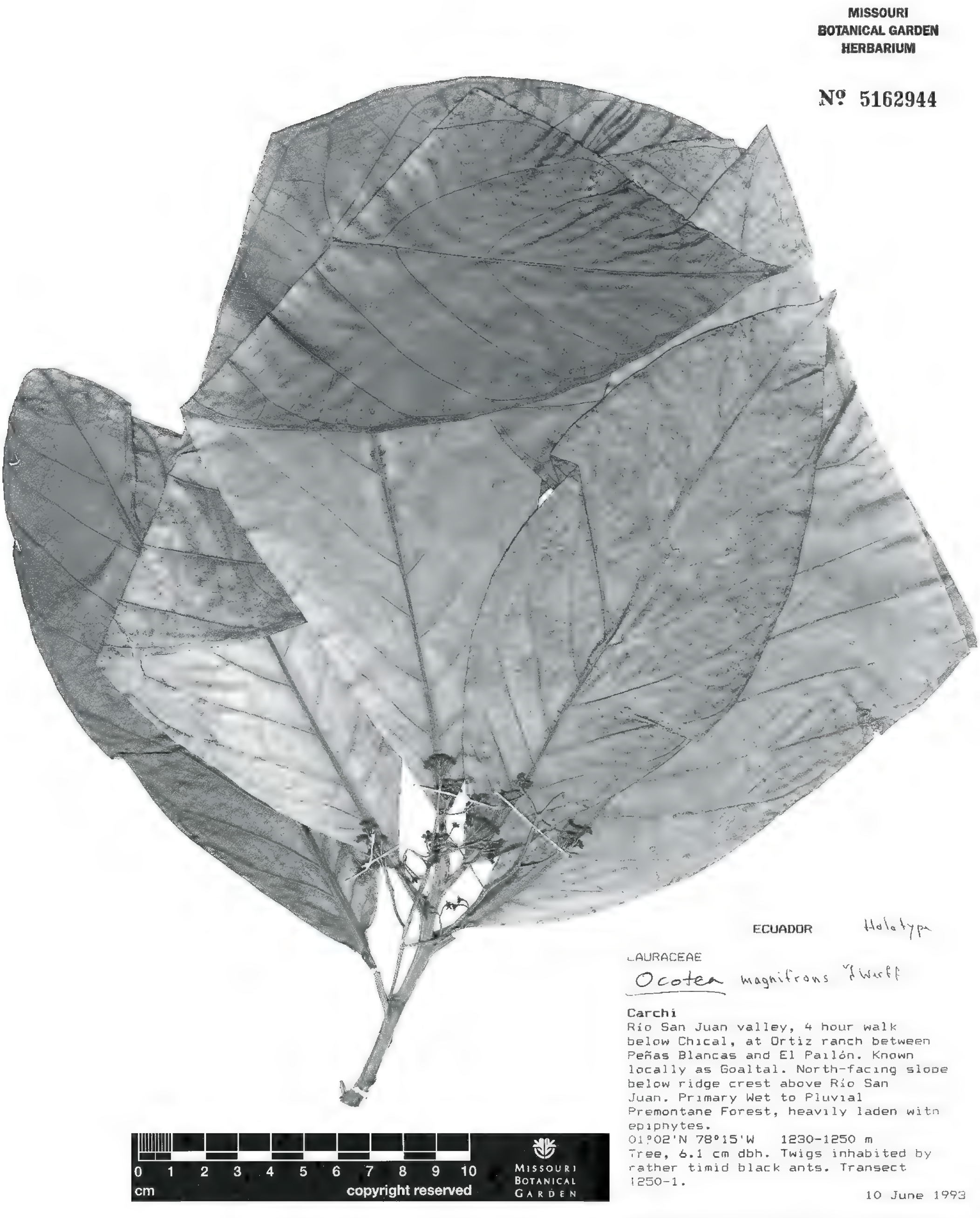

Figure 5. Holotype of *Ocotea magnifrons* van der Werff (*Boyle et al. 2063*, MO-5162944).

7. Ocotea obovatifolia van der Werff, sp. nov. TYPE. Ecuador. Bolívar: along rd. Chillanes–El Tambo, 1700–2300 m, 19 July 1991, *H. van der Werff, B. Gray & G. Tipas 12490* (holotype, MO-6327502; isotypes, B, COL, F, HBG, K, MA, NY, QCA, QCNE, US). Figure 6.

Ocoteae magnifrondi van der Werff similis, sed ab ea foliis obovatis, venatione camptodroma et ramulis adpresse pubescentibus recedit.

Trees, to 10 m; twigs sharply angular, hollow, 6–10 mm diam., moderately appressed pubescent; terminal buds densely appressed pubescent. Leaves 15–30 ×

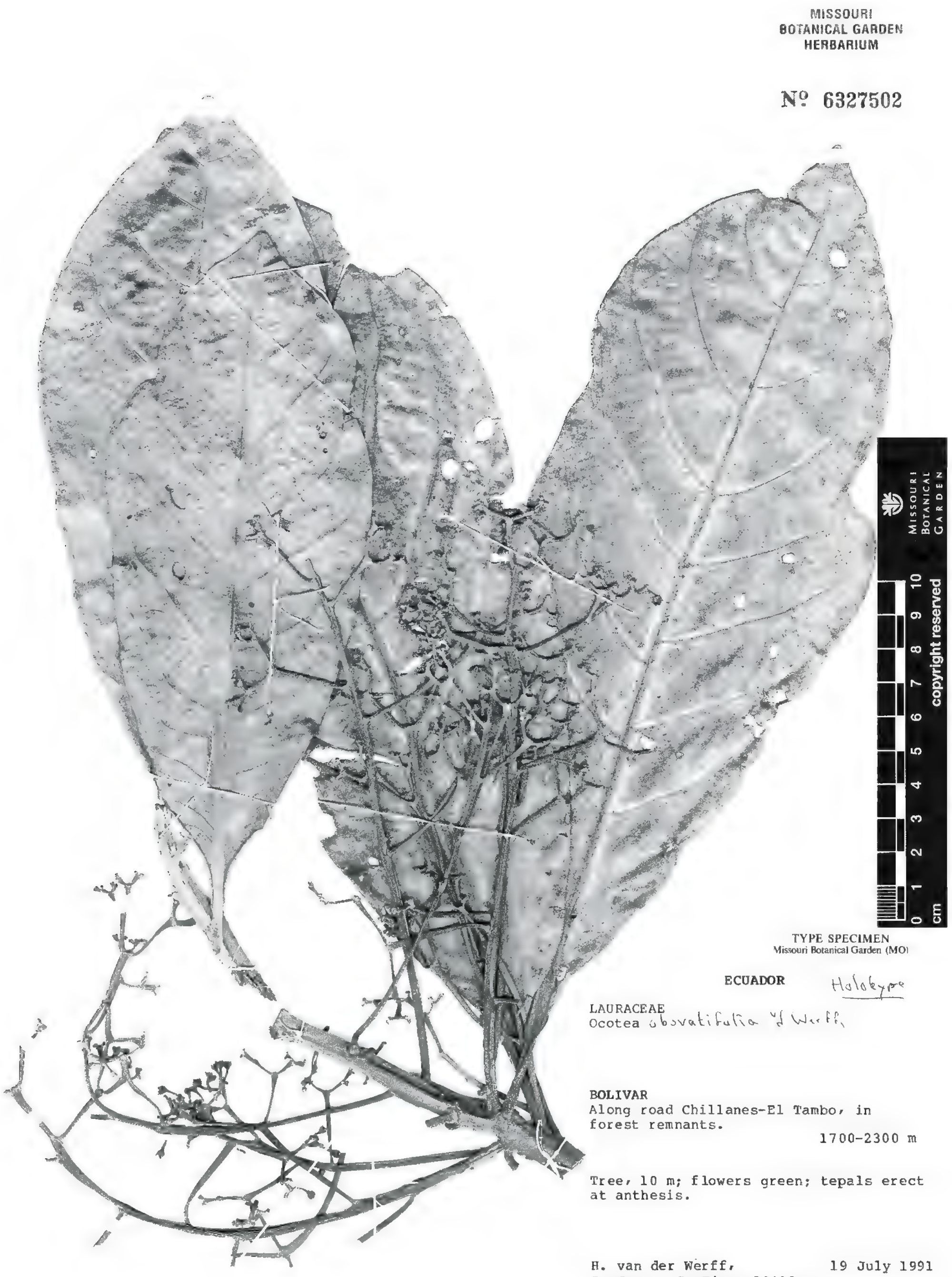

Figure 6. Holotype of *Ocotea obovatifolia* van der Werff (*van der Werff et al. 12490*, MO-6327502). Fruits are from *van der Werff et al. 12503* (MO).

6–13 cm, alternate, obovate or obovate-elliptic, thinly chartaceous, the base attenuate or acute, flat or slightly inrolled, the apex obtuse or rounded, glabrous or very sparsely appressed pubescent on the lower surface; venation immersed on the upper surface; venation slightly raised on the lower surface; domatia absent; secondary veins 6 to 9 on each side of the leaf, curved upward near the margin, but not loop-connected; petioles 12–19 mm, flat, not winged, with a similar indument as the twigs. Inflorescences

10–27 cm, paniculate-cymose, in the axils of leaves, moderately appressed pubescent. Flowers green, 3 mm diam., pedicels 4–5 mm; tepals 1.5 mm, broadly elliptic, appressed pubescent on the outer surface, glabrous or nearly so on the inner surface; stamens 9, all 4-celled, 1 mm, the anthers ca. 0.6 mm, glabrous, the outer 6 with the locelli introrse, inner 3 with the locelli lateral-extrorse and 2 globose glands at the base of the filament; staminodia not seen; pistil 1.8 mm, glabrous, the stigma plate-like, conspicuous, receptacle cup-shaped, glabrous inside. Fruit ellipsoid, 4.5 × 1.8 cm, cupule shallow, plate-like, with a single margin, 1 cm diam., the pedicel thickened.

Discussion. *Ocotea obovatifolia* can be recognized by the combination of fistulose twigs, leaves with an obtuse or rounded apex, relatively few pairs of secondary veins for the size of the leaves, and the large fruits seated on a small cupule. Immature cupules are cup-shaped, gradually narrowed into the pedicel, and have persisting tepals (*Croat 55777*, MO). At maturity, the cupule is plate-like, and the tepals have fallen off.

Ocotea obovatifolia can be confused with *O. magnifrons*; the two species differ in leaf shape (obovate in *O. obovatifolia* vs. elliptic in *O. magnifrons*), venation (secondary veins free in *O. obovatifolia* vs. distally loop-connected in *O. magnifrons*), and indument (hairs on twigs of *O. obovatifolia* appressed vs. those of *O. magnifrons* extremely short and largely erect).

Ocotea obovatifolia is known from five collections, all made on the western slope of the Andes in Ecuador. Flowering specimens were collected in April and July.

Paratypes. ECUADOR. **Bolivar:** along rd. Chillanes–El Tambo, 1700–2300 m, 19 July 1991, *H. van der Werff, B. Gray & G. Tipas 12492, 12503* (both at MO). **Cotopaxi:** 6 km NW of El Corazon on rd. to Quevedo, 1030 m, *T. Croat 55751, 55777* (both at MO).

Acknowledgments. I thank the curators of B, F, P, U, and US for making their collections available. Mike Blomberg and Fred Keusenkothen (MO) are acknowledged for their assistance with scanning and preparing images of the type specimens.

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Two New Infraspecific Taxa of *Orychophragmus violaceus* (Brassicaceae) in Northeast China

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ABSTRACT. Two new varieties of *Orychophragmus violaceus* (L.) O. E. Schultz (Brassicaceae) are described from Heilongjiang Province in northeastern China. The new variety, *O. violaceus* var. *odontopetalus* Ling Wang & Chuan P. Yang, differs from the typical variety of the species in that the petal has five or more obtuse teeth (vs. smooth petals) in the upper third of the expanded petal. The clawed petals have an expanded apical section that is 10–13 mm long (vs. 7–13 mm), and the stems and pedicels are puberulent (vs. glabrous). A second new variety is *O. violaceus* var. *variegatus* Ling Wang & Chuan P. Yang, which differs from the typical variety by the marked petal variegation of white and purple (vs. no petal variegation). The uppermost leaves are often undivided, with sharply serrate margins (vs. irregularly toothed leaves). These distinctions have persisted and been stable after eight years of cultivation in field experiments in Heilongjiang. A key to the infraspecific taxa of *O. violaceus* is included. Both new varieties are cataloged as of Least Concern (LC), based on IUCN Red List categories and criteria.

Key words: Brassicaceae, China, Cruciferae, Heilongjiang, IUCN Red List, *Orychophragmus*.

The genus *Orychophragmus* Bunge (Brassicaceae) was established in 1833 (Fu, 1980), based on the one species *O. sonchifolia* Bunge. A second species, *O. violaceus* (L.) O. E. Schulz, was added in 1916 and it was long accepted that only two species were known in East and Central Asia, with the one species in China as *O. violaceus* [≡ *Brassica violacea* L.]. This species is widely distributed in Heilongjiang, Jilin, Liaoning, Hebei, Shanxi, Henan, Shandong, Anhui, Jiangsu, Zhejiang, Jiangxi, Shaanxi, Gansu, and Sichuan provinces as wild and cultivated populations. From such broad geographic distribution and wide ranges of variation in leaf structure, shape, size, and indumentum, at least five additional varieties of *O. violaceus* have been described, including variety *homaeophyllus* (Hance) O. E. Schulz, variety *hupehensis* (Pamp.) O. E. Schulz (1923), variety *intermedius* (Pamp.) O. E. Schulz (1923), variety *subintegrifolius* (Pamp.) O. E. Schulz, and variety *lasiocarpus* Migo. New species considered to be closely related to *O. violaceus* were also described from China and include *O. taibaiensis* Z. M. Tan & B. X. Zhao (from Shanxi Province), *O. diffusus* Z. M. Tan & J. M. Xu, *O. limprichtianus* (Pax) Al-Shehbaz & G. Yang (both from Zhejiang), and *O. ziguiensis* Z. E. Zhao & J. Q. Wu.

Recent fieldwork and herbarium research by the authors support the discovery of two additional varieties of the species *Orychophragmus violaceus*. Both belong to this species because they share the same height, flowering time, and number of flowers per stem. The new variety *O. violaceus* var. *odontopetalus* Ling Wang & Chuan P. Yang differs from the typical variety in that the petals have five or more obtuse teeth (vs. ovate petals) on the upper third of the expanded blade. The clawed petals have an expanded apical section that is 10–13 mm long (vs. 7–13 mm), and the stems and pedicels are puberulent (vs. glabrous). The second new variety, *O. violaceus* var. *variegatus* Ling Wang & Chuan P. Yang, differs from the typical variety in that the petals are strikingly white and purple variegated (vs. no variegation). Its uppermost leaves are often undivided, with sharply serrate margins (vs. irregularly toothed). The two new taxa are described, particularly regarding the variable characters of the petals, which are taxonomically significant. These petal features remained stable after eight years of cultivation in field plots at the Northeast Forestry University campus at Harbin in Heilongjiang Province.

1. Orychophragmus violaceus (L.) O. E. Schulz, Bot. Jahrb. Syst. 54(3, Beibl. 119): 56. 1916. Basionym: *Brassica violacea* L., Sp. Pl. 2: 667. 1753. TYPE: China. Henan: Neixang Xian, Baotianman Nature Reserve Yinghu Gou, 20 May 1994, *D. Boufford, Liu, Ying, Zhang & Zhu 26131* (neotype, designated by Al-Shehbaz in Cafferty & Jarvis [Taxon 51: 532. 2002], A not seen; isoneotypes, E not seen, MO not seen).

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1a. Orychophragmus violaceus (L.) O. E. Schulz var. **violaceus**.

1b. Orychophragmus violaceus var. **odontopetalus** Ling Wang & Chuan P. Yang, var. nov. TYPE: China. Heilongjiang: Harbin, cultivated on campus of Northeast Forestry University (NEFU), 20 May 2009, *X. J. Ma, L. Wang & C. P. Yang 09009* (holotype, NEFI). Figure 1.

Haec varietas ab *Orychophragmo violaceo* (L.) O. E. Schulz var. *violaceo* petalis ad vel supra medium dentibus obtusis 5 vel plus praeditis, petalorum unguibus longioribus (10–13 mm longis) atque caulibus et pedicellis puberulis differt.

Herbs, annual or biennial, 10–50 cm tall; stems puberulent. Basal and lower leaves lyrate; petiole 2–4 cm; uppermost leaves often undivided, elliptic, 5–7 × 3–4 cm; apex acute, base auriculate, semi-amplexicaule, margin regularly serrate or rarely pinnatifid, lobes with few teeth. Flowers purple, 2–4 cm diam., pedicels 10–15 mm, puberulent; calyx tube purplish; petals 4, broadly obovate, with 5 or more obtuse teeth on expanded apical blade, expanded petal 10–13 mm long. Silique linear, 8–10 cm, quadrangular; seeds ovoid to oblong, 2 mm, black-brown.

Habitat and distribution. The plants were derived from naturally growing specimens from the Beijing Botanical Garden. The plants are common in Hebei, Liaoning, Shandong, Shanxi, Shaanxi, and Jiangsu provinces but do not grow in the wild in the Harbin area, Heilongjiang Province (Fu, 2003). However, the plants have been established as ornamental species throughout the Harbin metropolitan area.

IUCN Red List category. Because this is a widespread taxon in the above named provinces, the new variety is determined as of Least Concern (LC), according to IUCN Red List categories and criteria (IUCN, 2001).

Paratypes. CHINA. **Beijing:** Xiangshan, Beijing Botanical Garden, under trees, 22 Apr. 2006, *L. Wang 21012* (NEFI). **Heilongjiang:** Harbin, cult., residential area of NEFU, 20 May 2009, *L. Wang, X. J. Ma & Y. J. Bao 9014* (NEFI); Harbin Forest Farm of NEFU, forest edge, 18 May 2008, *L. Wang & X. Z. Zhang 8012* (NEFI). **Liaoning:** near town of Beizhen, roadsides, 6 May 2005, *L. Wang & C. P. Yang 4083* (NEFI).

1c. Orychophragmus violaceus var. **variegatus** Ling Wang & Chuan P. Yang, var. nov. TYPE: China. Heilongjiang: Harbin, cultivated on campus of NEFU, 18 May 2008, *L. Wang & X. J. Ma 8015* (holotype, NEFI). Figure 2.

Haec varietas ab *Oryochophragmo violaceo* (L.) O. E. Schulz var. *violaco* petalis albis purpureo-variegatis atque foliis summis 2 vel 3 saepe indivisis margine argute serratis recedit.

Herbs annual or biennial, 10–15 cm tall; stems glabrous. Basal and lower leaves lyrate, apex often undivided; petiole 2–4 cm; uppermost leaves often undivided, elliptic or oval, 4–7 × 2.5–4 cm; apex acute, base auriculate, semi-amplexicaule, margins sharply serrate. Flowers white and purple variegated, 2 cm diam., pedicels 8–15 mm, glabrous; calyx tube purplish; petals 4, broadly obovate, margins not toothed, expanded petal 7–13 mm long. Fruit a linear silique, length 7–10 cm, quadrangular; seeds ovoid to oblong, 1.5–2 mm, black-brown.

Habitat and distribution. The new infraspecific taxon is usually mixed with *Orychophragmus violaceus* in populations from Hebei and Liaoning provinces. These plants are found on plains, mountains, roadsides, and the edges of deciduous broad-leaved forest. *Orychophragmus violaceus* var. *variegatus* has a relatively strong capacity to adapt to diverse environments. Full sun to partial shade was observed as the best conditions for growth. The plants prefer soils rich in organic matter, which are moist and well-drained, but are moderately tolerant of dry and barren sites.

IUCN Red List category. Because this is a widespread taxon in Heilongjiang Province, the new variety is determined as of Least Concern (LC), according to IUCN Red List categories and criteria (IUCN, 2001).

Phenology. The new variety was observed to flower in April through May, with fruits seen in late May–June.

Discussion. The new variety *variegatus* differs from other varieties in *Orychophragmus violaceus* by the white and purple variegation of the petals. Its uppermost leaves are often undivided, and the leaf blade margins are sharply serrate.

Paratypes. CHINA. **Beijing:** Xiangshan, Beijing Botanical Garden, under trees, 22 Apr. 2006, *C. P. Yang & L. Wang 21015* (NEFI). **Heilongjiang:** Harbin, residential area of NEFU, cult. 21 May 2009, *Y. J. Bao 9019* (NEFI); Harbin Forest Farm of NEFU, forest edge, 18 May 2008, *L. Wang & X. J. Ma 8015* (NEFI). **Liaoning:** near town of Beizhen, roadsides, 6 May 2005, *L. Wang & C. P. Yang 4085* (NEFI).

Figure 1. *Orychophragmus violaceus* var. *odontopetalus* Ling Wang & Chuan P. Yang. —A. Holotype specimen, *X. J. Ma, L. Wang & C. P. Yang 09009* (NEFU). —B. Close-up of flower, showing the obtuse teeth on petals; taken from specimen at NEFU by the authors.

Figure 2. *Orychophragmus violaceus* var. *variegatus* Ling Wang & Chuan P. Yang. —A. Holotype specimen, *L. Wang & X. J. Ma 8015* (NEFU). —B. Close-up of flower, showing the purple and white variegation of the petals, taken from specimen at NEFU by the authors.

KEY TO THE INFRASPECIES OF *ORYCHOPHRAGMUS VIOLACEUS*

1a. Petals either marginally toothed or variegated in color 2
2a. Petals with 5 or more obtuse teeth above the middle, lacking variegation .... *O. violaceus* var. *odontopetalus*
2b. Petals with entire margins, strikingly white and purple variegated ..... *O. violaceus* var. *variegatus*
1b. Petals either not marginally toothed or lacking white and purple variegation 3
3a. Siliques densely villose .... *O. violaceus* var. *lasiocarpus*
3b. Siliques glabrous 4
4a. Plants dwarfed in size, 8–22 cm tall; siliques only 2.5–5.5 cm long *O. violaceus* var. *homaeophyllus*
4b. Plants taller, 20–65 cm tall; siliques 7–13 cm long 5
5a. Leaves with the terminal lobe entire or dentate, ovate or triangularly ovate .... *O. violaceus* var. *violaceus*
5b. Leaves with the terminal lobe obtusely toothed or incised 6
6a. Leaves with the terminal lobe unequally sinuate and obtuse-toothed, lateral lobes obliquely ovate or ovate-cordate; without lobules; calyx lobes sometimes villose at apex .... *O. violaceus* var. *hupehensis*
6b. Leaves with the terminal lobe irregularly incised, lateral lobes obliquely ovate, with lobules; calyx lobes glabrous in apex .... *O. violaceus* var. *intermedius*

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Ligustrum guangdongense (Oleaceae), a New Species from China

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Abstract. *Ligustrum guangdongense* R. J. Wang & H. Z. Wen (Oleaceae), from Guangdong, China, is described and illustrated. The new species is similar to *L. punctifolium* M. C. Chang and *L. morrisonense* Kaneh. & Sasaki, based on the small leaf blades and terminal inflorescences. *Ligustrum guangdongense* differs from *L. punctifolium* by having sparsely punctate glands on the abaxial leaf blade surface (vs. densely so), a corolla tube longer than the corolla lobes (1.6–1.9:1 vs. 1.1–1.3:1), and stamens that are included within (vs. exserted). *Ligustrum guangdongense* differs from *L. morrisonense* by having abaxially punctate leaf blades (vs. not punctate), typically 12 to 28 flowers in an inflorescence (vs. two or three), and a corolla tube that is shorter relative to the corolla lobes. The pollen grains of the new species are subprolate, with tricolpate apertures and a reticulate exine. The IUCN conservation status of *L. guangdongense* is assessed as Critically Endangered (CR).

Key words: China, IUCN Red List, *Ligustrum*, Oleaceae.

Ligustrum L. is a moderately sized genus in the Oleaceae and consists of approximately 37 species worldwide, of which at least 23 are found in China (Qin, 2009). *Ligustrum* is distributed in eastern and southern Asia, Europe, and Australia, with China seen as its modern center of species diversity (Qin, 2009). Plants of *Ligustrum* are either deciduous or evergreen shrubs or small trees, with opposite, simple, short petiolate leaves. Their inflorescences are generally terminal, as a panicle of cymes, with bisexual flowers that are either sessile or pedicellate. The flowers have a campanulate and truncate calyx that is 4-toothed and persistent. The flowers have a rotate, funnelform, or salverform corolla that is 4-lobed, with two stamens. The fruits are a berrylike drupe, with one to four seeds.

While investigating plants on the Dapeng Peninsula in Guangdong Province, China, we found an unknown shrubby plant among the mixed shrubs on the seashore. It is distinguished from previously recognized *Ligustrum* species and our comprehensive study confirms it as a new species.

Ligustrum guangdongense R. J. Wang & H. Z. Wen, sp. nov. TYPE: China. Guangdong: Shenzhen, Dapeng Peninsula, Xichong seaside, on sandy soil, N22°28′49″, E114°31′43″, 28 Feb. 2010, flowering, *R.-j. Wang 1285* (holotype, IBSC; isotypes, IBSC). Figure 1.

Diagnosis. *Ligustrum guangdongense* is similar to *L. punctifolium* M. C. Chang and *L. morrisonense* Kaneh. & Sasaki, but differs from *L. punctifolium* by having sparsely punctate glands on the abaxial leaf surface, a corolla tube that is relatively longer than the corolla lobes, and stamens that are included within the corolla tube. *Ligustrum guangdongense* differs from *L. morrisonense* by having abaxially punctate leaf blades, (5 to)12 to 28 flowers in an inflorescence, and shorter corolla lobes relative to the corolla tube.

Description. Shrubs, 2–4 m tall, evergreen; branchlets terete, sparsely pubescent to glabrescent. Leaf blades usually ovate, asymmetric, 2.5–3.6 × (0.8–)1.1–2 cm; blade texture papery to somewhat leathery, glabrous on both surfaces, but sparsely punctate abaxially; leaf base obliquely cuneate, apex obtuse to acute; secondary veins in 3 or 4 pairs, venation flush adaxially, but prominent abaxially; petiole 0.5–1.3 mm. Panicles terminal, with (5 to)12 to 28 flowers per inflorescence; flowers white, 7.5–9 mm diam. while open, flowering pedicels 1.7–6.8 mm. Calyx campanulate, 1.3–2 mm, glabrous, truncate, persistent, sometimes mostly dehiscent as carpels develop; corolla 8.4–11.5 mm; corolla tube (5–)5.5–7.1 mm, 1.6–1.9:1 longer than the lobes; corolla lobes 2.5–4.4 × 1.2–2 mm; stamens 2, included, reaching at most the throat of the corolla tube; anthers pale yellow, ca. 2.8 mm, versatile;

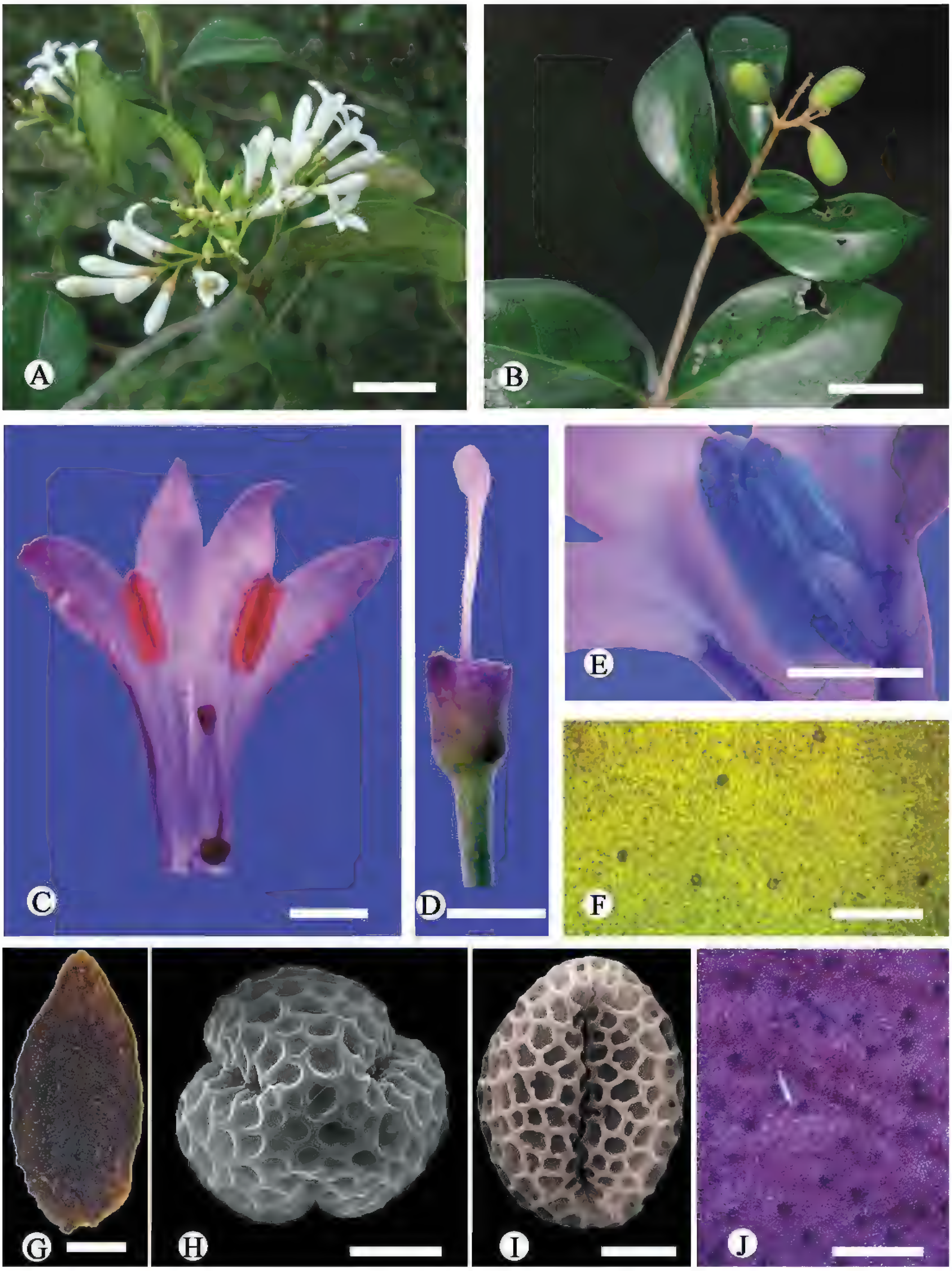

Figure 1. *Ligustrum guangdongense* R. J. Wang & H. Z. Wen. —A. Flowering branch. —B. Fruiting branch. —C. Floral dissection to reveal the inserted stamens and gynoecium. —D. Floral dissection to show the style and stigma. —E. Inserted stamens epipetalous on the corolla tube. —F. Abaxial leaf surface showing the punctate glands under light microscopy. —G. Seed. —H. Pollen grain in polar view. —I. Pollen grain in equatorial view. —J. Abaxial leaf surface showing the denser distribution of punctate glands in *L. punctifolium* M. C. Chang. Scale bars: A, B = 1 cm; C, E = 2 mm; D, F, G, J = 1 mm; H, I = 10 μm. Photographs were taken from the type locality by the corresponding author.

filaments ca. 1.5 mm; styles 3–4 mm, with stigma ca. 0.5 mm long. Fruit a drupe, obovoid when ripe, 3.5–4.5 mm, acute at apex, with a tip < 1 mm; seeds ca. 3 × 2 mm, oblong to ellipsoid, with indistinct longitudinal ridges.

Palynology. The pollen of the new species is a single grain that is subprolate to prolate, isopolar, and radially symmetric in shape, with tricolpate apertures and a reticulate exine. Pollen grains are medium-sized, 38.4(36.2–40.1) × 29.1(27.5–30.0) μm, with polar/equatorial (P/E) ratios of a mean of 1.32 (range, 1.29–1.35). These pollen characteristics are consistent with those of other *Ligustrum* species previously observed (Li et al., 1992).

Distribution and ecology. *Ligustrum guangdongense* is endemic to Dapeng Peninsula, and only four populations, each with less than 10 individuals, were found along the sandy seashore. Associates of these shrubs include small trees such as *Celtis sinensis* Pers. (Ulmaceae), *Syzygium odoratum* (Lour.) DC. (Myrtaceae), *Ficus hispida* L.f. (Moraceae), and *Pandanus tectorius* Parkinson (Pandanaceae). Other shrubs include *Elaeagnus oldhamii* Maxim. (Elaeagnaceae), *Atalantia buxifolia* (Poir.) Oliv. ex Benth. (Rutaceae), *Lantana camara* L. (Verbenaceae), and *Aporosa dioica* (Roxb.) Müll. Arg. (Euphorbiaceae). Liana associates include *Embelia laeta* (L.) Mez (Myrsinaceae) and *Morinda parvifolia* Bartl. ex DC. (Rubiaceae). The shade density was about 20%–40% for *Ligustrum guangdongense* at the type locality.

IUCN Red List Category. *Ligustrum guangdongense* is endemic to the Dapeng Peninsula, which has an attractive seashore with many visitors. All the presently known collections were from the type locality. The new taxon can be considered rare and its habitat is vulnerable and easily destroyed by human activities and destruction. According to the IUCN Red list criteria (IUCN, 2001), the new species is evaluated as Critically Endangered (CR), with this qualified as CR B2ab(i, iii)+D, referring to the area of occupancy as estimated to be less than 10 km^2, and the population size estimated to number fewer than 50 mature individuals.

Phenology. *Ligustrum guangdongense* was observed in flower from February to May; fruiting was noted from May to September.

Relationships. Based on the classification scheme of Qin (2009), *Ligustrum guangdongense* belongs to section *Ligustrum*, based on the ovate seeds with acute apices. The new species is similar to *L. punctifolium* and *L. morrisonense*, sharing small leaf blades that are often ovate. Leaves do not exceed 2 cm in length in either *L. punctifolium* or *L. morrisonense*, but are larger and range from 2.5 to 3.6 cm in the new species. The terminal panicles of pedicellate flowers distinguish both *L. punctifolium* and *L. morrisonense*. However, flowers are fewer, appearing in groups of no more than two or three on lateral branches, and are subsessile in *L. morrisonense*. These three morphologically similar taxa are geographically distinct. *Ligustrum punctifolium* occurs in floodplains in Hainan, Hong Kong, and Vietnam; *L. morrisonense* is known from mountainous ridges in Taiwan. The flowering season of the new species is noted from February to May, which differs from *L. punctifolium* (August) and *L. morrisonense* (April to July) (Chang et al., 1996).

A comparison between *Ligustrum guangdongense* and *L. punctifolium* reveals that the former has sparsely punctate abaxial leaf blade surfaces, with these glands distributed at a density of ca. 5.5 per mm^2. The abaxial glands are much denser, noted at a density of 26.3 per mm^2 in *L. punctifolium*. The relative lengths of the corolla tube to lobes are greater in *L. guangdongense* (1.6–1.9:1) than observed in *L. punctifolium* (1.1–1.3:1). Stamens distinguish both species and in *L. punctifolium* they are exserted, reaching the apex of the corolla lobes (vs. inserted in *L. guangdongense*). Anthers in *L. punctifolium* are 2.8 mm (vs. 2 mm in *L. guangdongense*); the filaments are longer, 2–2.5 mm (vs. 1.5 mm in *L. guangdongense*). Fertile pedicels are shorter in *L. punctifolium*, 0.5–1.5 mm, and are significantly longer in *L. guangdongense*, 1.7–6.8 mm. Leaves are more markedly asymmetrical at their bases in *L. guangdongense* (Chang et al., 1996).

Stamens are included within the corolla tube in both *Ligustrum guangdongense* and *L. morrisonense*. Leaves are asymmetrical at the base and abaxially punctate in the new species, in contrast to no glands and the more symmetrical blades of *L. morrisonense*. Flowers clearly distinguish both species, with two or three subsessile and lateral flowers seen in *L. morrisonense*, whereas flowers are grouped in terminal panicles of (five to)12 to 28 flowers that are pedicellate in *L. guangdongense*. Corolla lobes are relatively longer in *L. morrisonense*, with ratios of the corolla tube to the corolla lobes noted as (2.1–)2.5–4:1; in *L. guangdongense* these ratios are less, at 1.6–1.9:1.

Paratypes. CHINA. **Guangdong:** Shenzhen, Dapeng Peninsula, Xichong village, near seaside, 14 Apr. 2005 (fls.), *S.-z. Zhang & L.-q. Li 0008* (SZG); 28 Apr. 2005 (fls.), *S.-z. Zhang & L.-q. Li 0786* (SZG); 20 Apr. 2010 (fls., frs.), *R.-j. Wang 1307* (IBSC, MO); 16 Aug. 2010 (frs.), *R.-j. Wang 1422* (IBSC).

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Carex orestera (Cyperaceae), a New Sedge from the Mountains of California

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ABSTRACT. *Carex orestera* Zika (Cyperaceae) is described from western North America and is endemic to five counties in central and southern California in the Sierra Nevada range and the adjacent White Mountains. The taxon is separable from *C. albonigra* Mack. in its more lanceolate to oblong scales with a conspicuous pale midvein and relatively narrower perigynia. The new species is assigned to *Carex* L. sect. *Racemosae* G. Don, and a sectional key is provided for these sedges in California.

Key words: California, *Carex*, Cyperaceae, IUCN Red List.

Carex L. sect. *Racemosae* G. Don (Cyperaceae) is a northern hemisphere group of ca. 60 species with 11 indigenous species reported from California (Murray, 2002). One widespread member of the section is *C. albonigra* Mack., with a range from Alaska to Arizona in western North America. Specimens called *C. albonigra* from California have puzzled caricologists, because the specimens do not agree with typical Rocky Mountain plants (Murray, 1969, 2002; Wilson et al., 2008; Taylor, 2011; Zika et al., 2012). The Californian populations are described here as a novelty. The new sedge was first collected in 1930 by F. W. Peirson.

Carex orestera Zika, sp. nov. TYPE: U.S.A. California: Mono Co., subalpine talus, above NW end of Gardisky Lake, 3250 m, 11 Aug. 2010, *P. F. Zika 25338 & S. Matson* (holotype, WTU; isotypes, CAN, CAS, CHSC, GH, JEPS, MICH, MO, NY, OSC, RSA, US). Figures 1, 2A, C.

Haec species a *Carice albonigra* Mack. squamis femineis oblongis costa pallida conspicua atque perigyniis pro ratione angustioribus differt.

Plants perennial, densely to loosely caespitose; rhizomes short or slightly elongated, 1–30 × 1.5–2.5 mm, clothed in light brown to mid brown scales, sometimes slightly fibrous; fertile stems (culms) sharply triangular, scabrous distally, longer than leaves, 3.5–39 cm tall, papillose at 20×, phyllopodic, 4 to 10 stem leaves on lower third of stem, rarely 1 bractlike leaf with blade 1–9.5 cm arising from midstem; sterile leafy shoots in rosettes, with 1 or 2 bladeless scalelike basal leaves. Stem bases light brown, sometimes suffused with red-purple. Leaves blue-green, glabrous, papillose adaxially and abaxially, blades folded in V- or W-shape when fresh, sometimes flattening with age, abaxial surface with midvein more pronounced than lateral veins, margins scabrous, blades 20–110 × 1.3–3.5 mm; sheath faces smooth, white to translucent or pale brown, truncate or shallowly notched, not fibrillose, often overlapping and obscured. Inflorescences dark purple, erect, 14–60 × 4–12 mm; 2 to 4(5) ascending spikes, in elliptic to ovate (rarely oblong) cluster, rarely basal spikes separated 15–33 mm; inflorescence bract green or more usually dark purple with green midvein, sheath 0–4 mm, blade green or purple and green, 0–65 mm; basal spike subsessile, rarely on erect peduncle 3–21 mm; lateral spikes pistillate, narrowly oblong to lance-oblong, 4–12(–19) × 2.5–5 mm; terminal spike 7–20 × 4–8.5 mm, mostly mixed sex, perigynia usually terminal and spike ♀/♂ (gynecandrous) or ♀/♂/♀, rarely ♀/♂, ♂/♀ (androgynous), or ♂, staminate portion of spike usually less than 70% of length; scales from lower half of lateral pistillate spikes usually lanceolate to oblong or elliptic, narrowly ovate, sometimes narrowly elliptic, elliptic-ovate, or ovate, dark purple, smooth or papillose to scabrous distally, midvein usually pale and conspicuous, 2.7–3.7 mm, margins with narrow hyaline zone 0.05–0.5 mm wide, hyaline margin broadest on staminate scales, base clasping rachis, apex blunt, acute, or acuminate, sometimes with mucro 0.1–0.3 mm, scabrous or not. Perigynia mostly oblanceolate to narrowly elliptic, less common variants are elliptic to obovate or broadly elliptic, trigonous or somewhat flattened but bulging over achene, dark purple or largely so on a green background, the green aging to golden brown, not scabrous, papillose at 20×, 2.4–3.6 × 0.9–1.4(–1.6) mm, faces nerveless or 1 to 3 faint adaxial nerves, 1 to 6 faint abaxial nerves, base

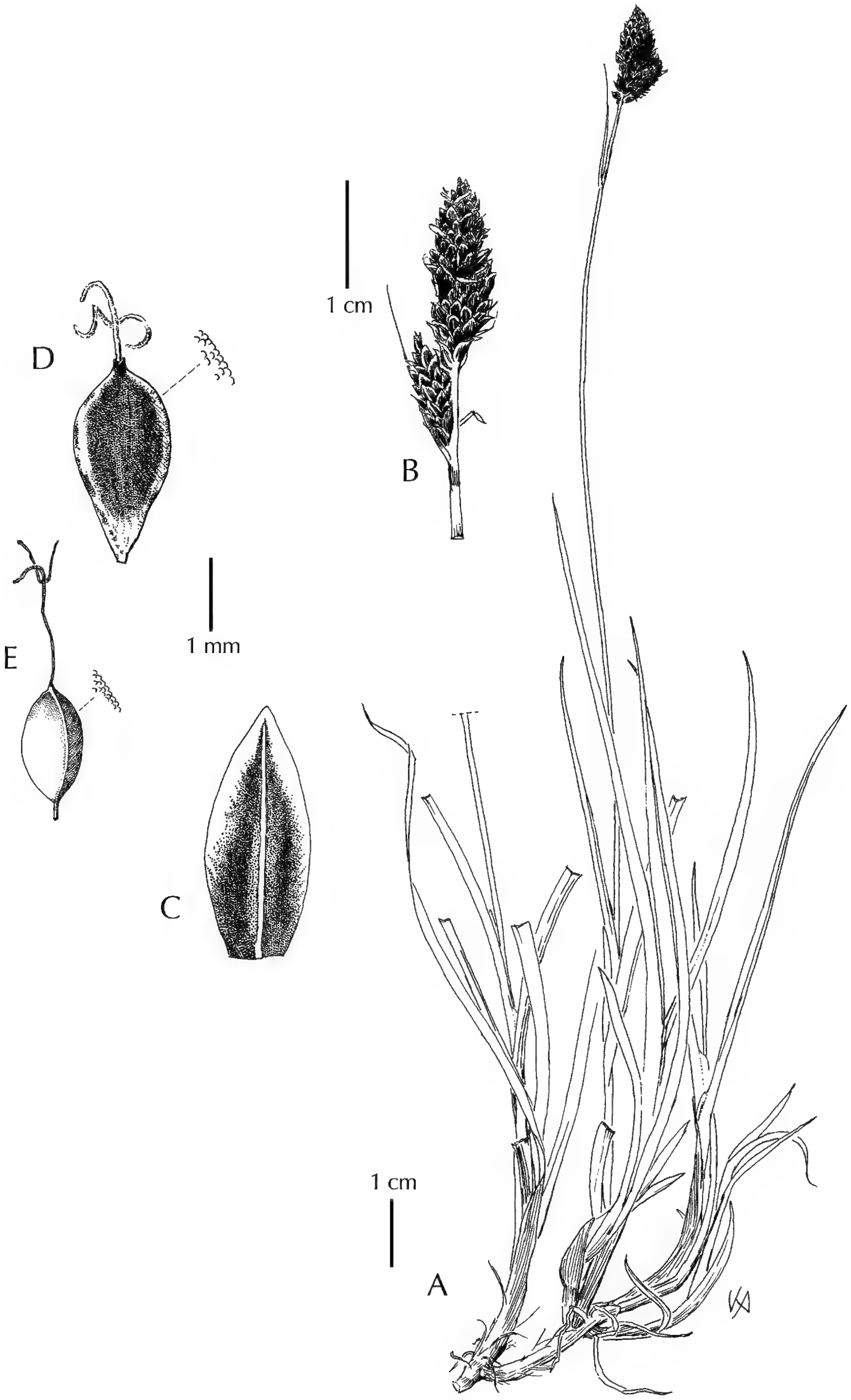

Figure 1. *Carex orestera* Zika. —A. Habit. —B. Inflorescence. —C. Pistillate scale. —D. Perigynium, showing papillose surface in magnification at right. —E. Achene, showing stipe and papillose surface. A–E were taken from the holotype *P. F. Zika 25338 & S. Matson* (WTU).

acute to acuminate, apex abruptly tapered to distinct beak 0.2–0.3 mm; beak teeth acute, 0.1–0.15 mm, dark purple, white-tipped, inconspicuous; anthers 2.2–3.5 × 0.3–0.4 mm when dehisced, including terminal awn 0.1–0.2 mm; stigmas 3, plumose, exserted. Achenes mid brown, trigonous-elliptic, surface granular at 20×, body 1.2–1.6 × 0.7–0.95 mm, not including stipe or style, stipe (0–)0.2–0.4

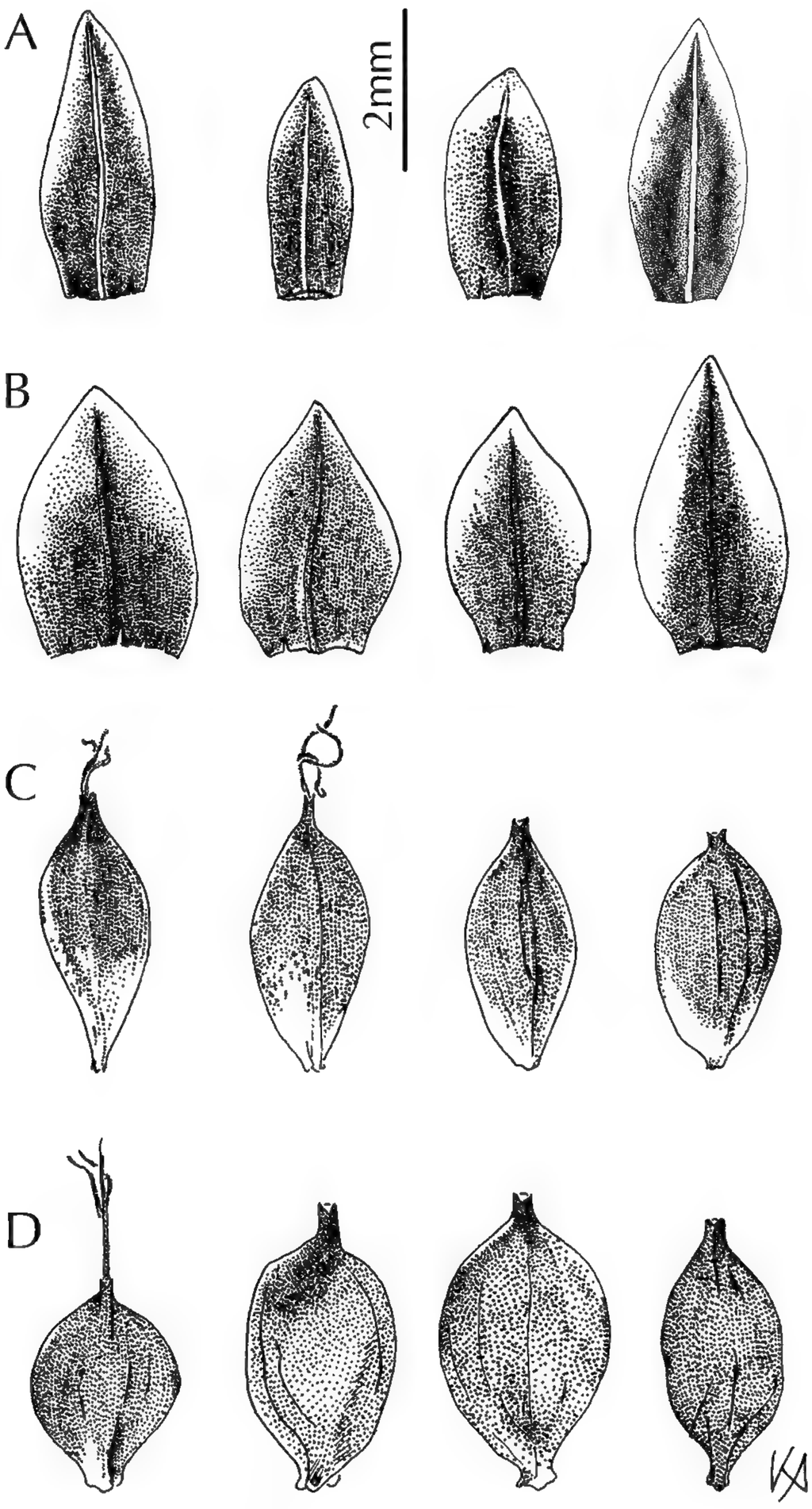

Figure 2. A, B. Pistillate scales from proximal half of spike. —A. *Carex orestera* Zika (left to right, from *P. F. Zika 25359*, three from *P. F. Zika 25338 & S. Matson* [type], all WTU). —B. *C. albonigra* Mack. (left to right, two from *D. T. Macdougal 408*, *P. F. Scholander S-186*, *W. Flagg, J. Barrell & S. Spongberg 116–66*, all US). C, D. Mature perigynia from lower third of spike. —C. *C. orestera* (left to right, two from *P. F. Zika 25359*, two from *P. F. Zika 25338*, all WTU). —D. *C. albonigra* (left to right, from *Barrell 116–66*, two from *Macdougal 408*, *Scholander S-186*, all US).

mm, style remnant 0.05–0.9 mm; achenes filling more than half the perigynium.

Distribution and habitat. *Carex orestera* is restricted to five counties in the central and southern high Sierra Nevada and White Mountains ecoregions of California in the United States (Hickman, 1993; Fig. 3). Habitats are near treeline and include dry to mesic rocky slopes, boulder fields, the shores of meltwater pools and streamlets and are always in full sun from elevations of 3000 to 4130 m (Lloyd & Mitchell, 1973). Most populations are found on granodiorite, but there are collections from sedimentary bedrock (limestone and sandstone), volcanics (including felsic flows and tephrite), and metamorphics (hornfels) that are occasionally somewhat limy (Consortium of California Herbaria, 2011).

Common or characteristic associates include: *Botrychium simplex* E. Hitchc. (Ophioglossaceae), *Calamagrostis muiriana* B. L. Wilson & Sami Gray (Poaceae), *Carex breweri* Boott (Cyperaceae), *C. filifolia* Nutt. var. *erostrata* Kük., *C. fissuricola* Mack., *C. helleri* Mack., *C. nigricans* C. A. Mey., *C. phaeocephala* Piper, *C. rossii* Boott, *C. spectabilis* Dewey, *C. subnigricans* Stacey, *C. vernacula* L. H. Bailey, *Deschampsia cespitosa* (L.) P. Beauv. (Poaceae), *Ivesia lycopodioides* A. Gray (Rosaceae), *Juncus drummondii* E. Mey. (Juncaceae), *Lupinus lepidus* Douglas ex Lindl. (Fabaceae), *Luzula orestera* Sharsm. (Juncaceae), *L. spicata* (L.) DC., *Oxyria digyna* (L.) Hill (Polygonaceae), *Pedicularis attollens* A. Gray (Orobanchaceae), *Phlox diffusa* Benth. (Polemoniaceae), *Pinus albicaulis* Engelm. (Pinaceae), *Podistera nevadensis* (A. Gray) S. Watson (Apiaceae), *Potentilla bruceae* Rydb. (Rosaceae), *P. drummondii* Lehm., *P. fruticosa* L., *Salix eastwoodiae* Cockerell ex A. Heller (Salicaceae), *S. petrophila* Rydb., *Solidago multiradiata* Aiton (Asteraceae), and *Trisetum spicatum* (L.) K. Richt. (Poaceae).

IUCN Red List category and conservation concerns. *Carex orestera* has a small global range, measuring roughly 170 × 80 km (Fig. 3). Verified herbarium records document a total of 41 known populations. Inventories of population size and stability are needed. Colonies I have visited are usually small, with fewer than 50 genets. Although their high elevation habitats seem remote from most human disturbance, exotic seed-eating animals, like white-tailed ptarmigan (*Lagopus leucurus* Richardson, introduced to California in 1971; Frederick & Gutiérrez, 1992), and climate change may represent long-term threats. By IUCN (2001) criteria, this taxon is assessed as Least Concern (LC).

Phenology. Ripe perigynia are found from mid-July to the first week of September, but many July collections are immature.

Etymology. The Greek epithet *orestera* refers to its mountain habitat, as does the vernacular name boulder sedge.

Discussion. Morphologically, *Carex orestera* appears to be most closely related to *C. albonigra*. Both are in *Carex* sect. *Racemosae* and found in similar habitats. The taxa share a loosely to densely

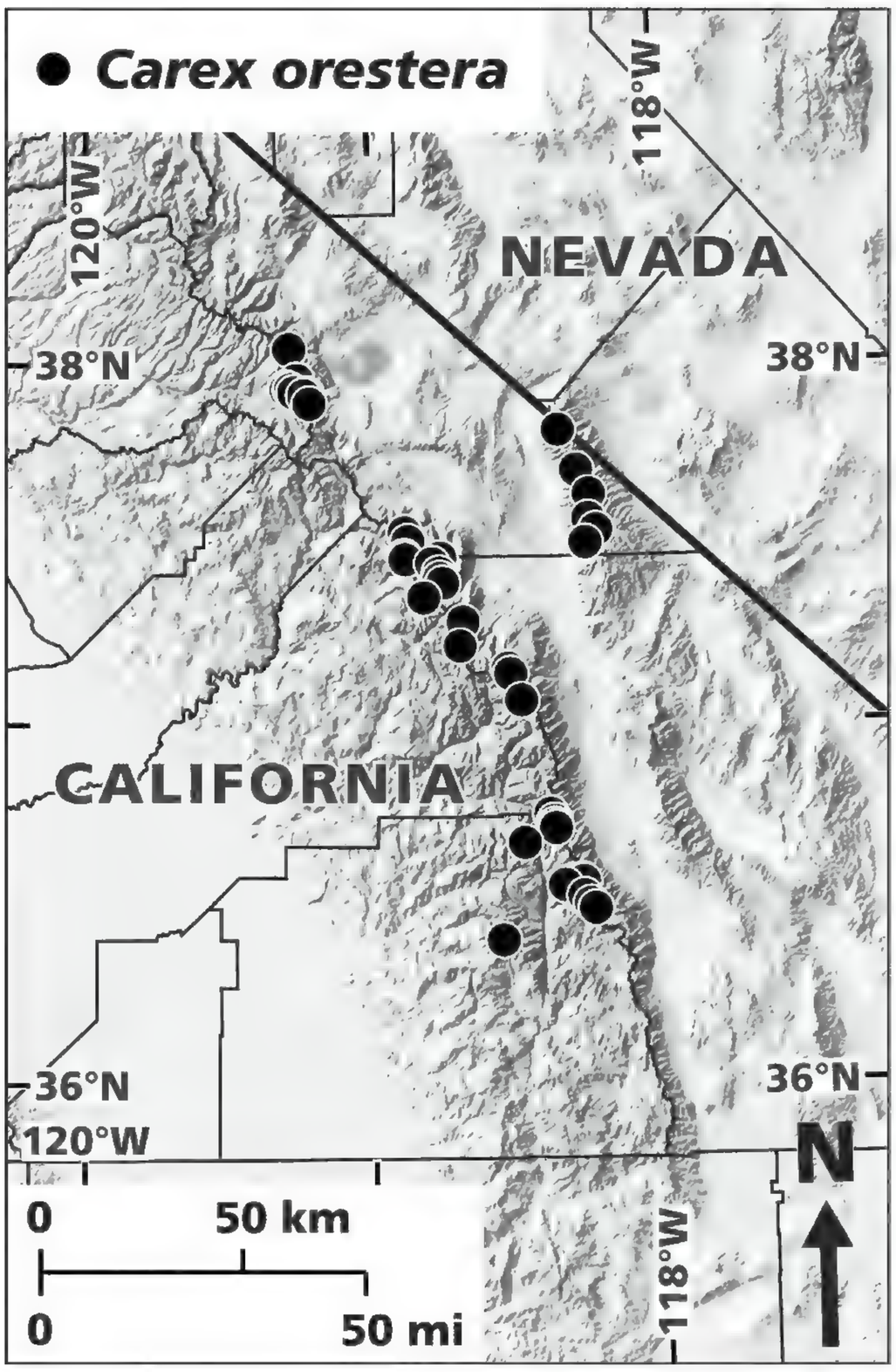

Figure 3. Distribution map of *Carex orestera* Zika, based on voucher specimens at the herbaria cited in the acknowledgments.

caespitose habit, dark and small, erect inflorescences with overlapping spikes, essentially gynecandrous terminal spikes, and dark purple scales. In addition, at 20× magnification, they share papillose perigynia, foliage, and stems, and sometimes the scales are papillose as well, demarcating them both from *C. heteroneura* W. Boott, which has essentially no papillae on the perigynia, scales, and stems, and often grows at elevations below 3000 m. The similar *C. helleri* is found near treeline growing with *C. orestera*, but *C. helleri* has essentially no papillae on the perigynia, has occasional papillae on some scale midveins, and differs in the lower pistillate scales with their distinctive awns, often more than 0.5 mm. The corresponding scale tips of *C. orestera* are unawned, or sometimes bear a short mucro up to 0.3 mm. In the field, *C. helleri* usually looks quite different with larger, wider spikes in a broader and denser headlike cluster.

Table 1 shows a comparison of critical characters for *Carex orestera* and *C. albonigra*. The base of the stem is often different. Carefully made collections of *C. albonigra*, showing the basal scales on fertile stems and new shoots, are usually purple, and at 10× show no more than a few fibers as the scales age. In contrast, roughly a third of the collections of *C. orestera* are purple at the base, while the rest are brown. *Carex orestera* stem bases can be slightly or moderately fibrous. In the inflorescence, *C. albonigra* typically has dark purple scales with an inconspicuous dark midvein, while *C. orestera* has a prominently contrasting pale or whitish midvein. Mature scale shape (when perigynia are mature) can be useful in *Carex* sect. *Racemosae*, although many species are curved and slightly clasping at the base, making it difficult to see their outline even with dissection from the spike. Extensive samples of species of this section tend to show much more variation in scale and perigynium shape than usually credited in floras and is one reason that existing identification keys can be challenging. Both *C. albonigra* and *C. orestera* are found near timberline and tolerate a broad range of soil moisture, bedrock, snow cover, and wind. Some of their variation in scale and perigynium shape may be a phenotypic response

Table 1. Morphological comparison of *Carex albonigra* and *C. orestera*. Scales and perigynia are taken from the lower half of pistillate, lateral spikes.

Character	*C. albonigra*	*C. orestera*
Common ♀ scale shape	broadly elliptic to broadly ovate, elliptic-ovate, oblong-ovate	lanceolate to oblong or elliptic, narrowly ovate
Uncommon ♀ scale shape	elliptic-oblong, oblong, elliptic, ovate	narrowly elliptic, elliptic-ovate, ovate
♀ scale midvein	usually dark, not contrasting with scale body	usually pale, strongly contrasting with scale body
Common perigynium shape	broadly elliptic to broadly obovate, obovate, broadly ovate	oblanceolate to narrowly elliptic
Uncommon perigynium shape	elliptic	elliptic to obovate, broadly elliptic
Perigynium length (mm)	2.3–3.7	2.4–3.6
Perigynium width (mm)	(1.1–)1.4–2.3(–2.5)	0.9–1.4(–1.6)
Achene base	sessile or essentially so	stipe 0.2–0.4 mm, sometimes sessile
Stem base	usually purple, faintly fibrous	brown or purple, faintly or moderately fibrous

to gradients in moisture and exposure. Murray (1969) noted that scales from the distal fourth of the spike should not be regarded as typical in *Carex* sect. *Racemosae*. Similarly, the distal perigynia, as in many *Carex*, also tend to be atypically narrow. *Carex albonigra* scales are usually broadly elliptic to broadly ovate on the lower half of the lateral spikes with variations (Table 1, Fig. 2B). The corresponding scales of *C. orestera* are usually relatively narrower and more lanceolate to oblong with variations (Table 1, Fig. 2A). The perigynia of *C. albonigra* are often more than 1.6 mm wide, and thus can be wider than *C. orestera* (Table 1). However, poorly developed or bent perigynia of *C. albonigra* can be as narrow as the widest *C. orestera* perigynia, and in these cases, shape helps distinguish them. *Carex orestera* perigynia tend to be oblanceolate to narrowly elliptic (Fig. 2C), while *C. albonigra* perigynia are typically broadly elliptic to broadly obovate, with variations (Fig. 2D). Exceptional perigynia can be confusing (see perigynia at far right in Fig. 2C, D), but the majority show the characteristic shapes described in Table 1. Finally, the two species are allopatric. *Carex albonigra* is essentially a plant of the Rocky Mountains, approaching California no closer than the San Francisco Mountains of Coconino County, Arizona, 600 km to the east of the White Mountains. *Carex albonigra* illustrations in Mackenzie (1940), Cronquist (1969, 1977), and Murray (2002) were based on specimens of *C. albonigra*, not *C. orestera*.

Key to taxa. A key is provided for all members of *Carex* sect. *Racemosae* in California. Fully mature perigynia with ripe achenes are required as well as basal parts of the plant. Pistillate scale shape is often useful, but scales from the upper fourth of a spike are often narrower than typical and should not be used (Murray, 1969). Terminal spikes are typically ♀/♂ (gynecandrous) in the section, but can vary, even on one plant, to ♂/♀ (androgynous), or ♀/♂/♀. *Carex heteroneura* uncommonly has some stems on a clump with entirely staminate terminal spikes, including the holotype at GH (Murray, 2002). From viewing such plants in the field, I have found an adequate sample of *C. heteroneura* will show many "typical" gynecandrous terminal spikes.

Two species reported by Murray (2002) from California are not included in the key below. The first is *Carex bella* L. H. Bailey, based on a 16 July 1959 gathering from Mariposa County, Yosemite National Park, three miles northeast of Chinquapin, Glacier Point Road, 7000 ft. (*L. S. Rose 59143*, CAS, WTU). After examining plants at this location, and Rose's herbarium vouchers, I believe the plants are merely a robust form of *C. heteroneura*, which occasionally has elongate spikes and somewhat drooping peduncles and thus can resemble *C. bella*. However, the California plants have lateral spikes entirely pistillate, and the pistillate scales do not strongly clasp the perigynia. *Carex bella* specimens from Arizona and further east have diagnostic strongly clasping scale bases wrapped around the lower third of the perigynia and usually have gynecandrous lateral spikes with a few proximal staminate flowers. A second species of *Carex* sect. *Racemosae* noted for California is *C. epapillosa* Mack. (Mastrogiuseppe, 1993; Murray, 2002). It is not in the key, because I could not find consistent differences between it and *C. heteroneura* when examining the morphological variation of the complex from California to Wyoming. Intermediate specimens are common, as are collections that combine various features of both taxa, especially in California and Oregon. The most recent California flora considers *C. epapillosa* synonymous under the earlier name *C. heteroneura* (Zika et al., 2012).

KEY TO SPECIES INCLUDED IN *CAREX* SECT. *RACEMOSAE* IN CALIFORNIA

1. Proximal pistillate scales long-awned to acuminate, awns usually 0.5–2 mm or longer 2
2. Plants caespitose; perigynia smooth at 20×; proximal leaf sheaths not fibrous; dry slopes near or above treeline ..... *C. helleri*
2′. Plants rhizomatous; perigynia papillose at 20×; proximal leaf sheaths ladder-fibrillose; shores, wet meadows, and peatlands below treeline ..... *C. buxbaumii* Wahlenb.
1′. Proximal pistillate scales acute to acuminate, sometimes with a short mucronate apex or short awns < 0.5 mm 3
3. Perigynium surface smooth, not papillose at 20× (occasionally faintly papillose at 40×) 4
4. Mature lateral spikes ♀/♂ (gynecandrous), proximal scales subtending filaments from ♂ flowers ..... *C. mertensii* J. D. Prescott ex. Bong.
4′. Mature lateral spikes ♀ (pistillate), proximal scales subtending perigynia 5
5. Terminal spikes always ♂ (staminate); perigynia slightly inflated ..... *C. raynoldsii* Dewey
5′. Terminal spikes usually ♀/♂ (gynecandrous, rarely ♂ on some stems; other stems always ♀/♂); perigynia flattened over achenes, not inflated ..... *C. heteroneura*
3′. Perigynium surface papillose at 20× 6
6. Terminal spikes, or some of them, ♂/♀ (androgynous) or completely ♂ (staminate) 7
7. Plants rhizomatous to loosely caespitose; perigynia 2–3 mm; spikes 3–5 mm wide; meadows 2800–3400 m, over dolomite ..... *C. idahoa* L. H. Bailey
7′. Plants caespitose; perigynia usually 3–5 mm; spikes 6–11 mm wide; damp slopes below 1800 m, often over serpentine .... *C. serratodens* W. Boott
6′. Terminal spikes usually ♀/♂ (gynecandrous) 8
8. Perigynia mostly ovate ..... *C. serratodens*
8′. Perigynia elliptic to obovate or oblanceolate 9

9. Perigynia green to olive-green, ripening to an iridescent golden, conspicuous and strongly contrasting with the much shorter and darker scales; scale midvein dark and inconspicuous against dark scale body ... *C. stevenii* (Holm) Kalela
9′. Perigynia dark purple or dark brown (rarely yellow), inconspicuous against scales or hidden by them; scale midvein usually pale and conspicuous against dark scale body 10
10. Perigynium upper body and beak scabrous-bristly, on at least some perigynia; pistillate scales broadly elliptic to obovate in proximal half of spike; scale tips or awns sometimes bristly; plants rhizomatous to loosely caespitose ... *C. idahoa*
10′. Perigynium upper body and beak not scabrous-bristly; pistillate scales usually lanceolate to oblong or elliptic, sometimes narrowly ovate in proximal half of spike; scale tips or awns not bristly; plants caespitose to loosely so ... *C. orestera*

Paratypes. U.S.A. **California:** Fresno Co., S of Mount Muriel, 3718 m, 23 July 1952, *P. H. Raven 4666* (CAS); Palisades N of Palisade Lakes, 3535 m, 17 July 1956, *P. H. Raven 9747* (CAS); Lake Italy, 3393 m, 3 Aug. 1954, *P. H. Raven 7758* (CAS); second rocky canyon step above Mott Lake, 3108 m, 30 Aug. 1952, *C. H. Quibell & E. Quibell 1534* (CAS); Fourth Recess, 3078 m, 19 July 1946, *J. T. Howell 22527* (CAS, US); Inyo Co., Mt. Whitney, Consultation Lake, 3590 m, 19 July 1954, *P. H. Raven & G. T. Robbins 7478* (CAS); head of Lone Pine Canyon, [mixed w/ *Carex subnigricans*], 3658 m, 22 Aug. 1937, *C. W. Sharsmith 3371* (CAS, UC, US); Inconsolable Range above Thunder & Lightning Lake, 3658 m, 14 Aug. 1947, *J. T. Howell 24105* (CAS); W of Sixth Lake, Big Pine Lakes, 3415 m, 7 Aug. 1947, *J. T. Howell 23873* (CAS, RSA); Army Pass, 3659 m, 5 Aug. 1949, *J. T. Howell 26055* (CAS, DS, RSA, UC, US); W side of Morgan Pass, Rock Creek Lake basin, 3375 m, 16 July 1946, *J. T. Howell 22466* (CAS); Long Lake, Rock Creek Lake basin, 3230 m, 16 July 1946, *J. T. Howell 22450* (CAS); Mono Mesa, 3658 m, 26 July 1946, *J. T. Howell 22715* (DS, GH, US); unglaciated plateau just N of summit of Mt. Humphreys, 3925 m, 11 Aug. 1937, *C. W. Sharsmith 3119* (CAS, UC); Mono Co., NE slope of Sheep Mtn., White Mtns., 10 Aug. 1963, *R. M. Lloyd 3262* (CAS, UC); bottom of cirque heading N of fork of Perry Aiken Creek, 1.1 mi. E of White Mtn. peak, 3502 m, 25 July 1987, *J. D. Morefield & T. S. Ross 4698* (RSA); upper subalpine slopes of Chiatovich Flats, head of Cabin Creek, 3535 m, 31 July 1982, *D. W. Taylor 8073* (UC [terminal spikes atypical ♀/♂, ♂/♀, or ♂]); 1 mi. S of Barcroft Lab, 3658 m, 12 Aug. 1969, *S. N. Zufelt & R. K. Gierisch 79* (CAS); Dana Plateau, Mt. Dana, 15 July 1937, *C. W. Sharsmith 2495* (CAS), 1 Sep. 1937, *C. W. Sharsmith 3516* (UC), 10 Aug. 1944, *J. T. Howell 20279* (CAS); 0.5 km SW of Frog Lakes, 3200 m, 18 Aug. 2010, *P. F. Zika 25373* (CAS, JEPS, MICH, OSC, V, WS, WTU); 1.5 km S of Finger Lake, 3590 m, 17 Aug. 2010, *P. F. Zika 25359* (ASC, DAV, HSC, RENO, WTU); ridge N of W Granite Lake, 3375 m, 17 Aug. 2010, *P. F. Zika 25353 & A. Colwell, D. W. Taylor* (CHSC, MONTU, NY, SD, UBC, UCR, WTU); Tulare Co., John Muir Trail W of Center Peak, 3200 m, 30 July 1948, *J. T. Howell 25206* (RSA); Bubbs Creek Canyon, 3140 m, 26 July 1948, *J. T. Howell 25024* (CAS, RSA); near Primrose Lake, 3444 m, 24 July 1949, *J. T. Howell 25684* (CAS), *25691* (US); near tarn E of Farewell Gap, 3353 m, 20 July 1951, *J. T. Howell 27037* (CAS, US); Crabtree Creek, 3353 m, 21 July 1954, *P. H. Raven 7501* (CAS); Tuolumne Co., tarn at E end of Upper Gaylor Lake, NW of Gaylor Peak, Yosemite Natl. Park, 3220 m, 17 Aug. 2010, *P. F. Zika 25351 & A. Colwell, D. W. Taylor* (UC, WTU, YM); bowl near Sierra Nevada crest, Skelton Plateau, 2 air km SSW of Spuller Lake, Yosemite Natl. Park, 3560 m, 17 Aug. 2010, *P. F. Zika 25355 & A. Colwell, D. W. Taylor* (UC, WTU, YM).

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Validation of the Name *Veratrum hybridum* (Liliales, Melanthiaceae): The Correct Name for Crisped Bunch-Flower

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Abstract. Daniel B. Ward's recent assessment of species in *Flora Caroliniana* by Thomas Walter included the identification and neotypification of *Melanthium hybridum* Walter, a name that would now have apparent priority over the more commonly used synonyms for the crisped bunch-flower, *M. latifolium* Desr. in Lam. and *Veratrum latifolium* (Desr. in Lam.) Zomlefer (Melanthiaceae). The supported conservation of the name *Veratrum* L. over *Melanthium* L. at the Melbourne International Botanical Congress necessitates the transfer of *M. hybridum* to *Veratrum*. However, another name, *V. hybridum* J. H. Zimmerman, lacked reference to the basionym and was not validly published. Herein, a discussion of these nomenclatural issues includes the validation of the name *V. hybridum* (Walter) Zimmerman ex Zomlefer.

Key words: Liliales, Melanthiaceae, Melanthieae, *Melanthium*, *Veratrum*.

The crisped bunch-flower, commonly known as *Melanthium latifolium* Desr. in Lam. (e.g., Bodkin & Utech, 2002) or *Veratrum latifolium* (Desr. in Lam.) Zomlefer (e.g., Zomlefer, 1997), is a perennial species inhabiting well-drained wooded slopes (300–1700 m) mainly in the eastern United States, from Connecticut to southeastern New York south to South Carolina, Georgia, and eastern Tennessee and is disjunct in north-central Arkansas (Zimmerman, 1958; Bodkin, 1978). Verifying the correct name for this widespread plant has immediate relevance for many contemporary floras of this region (e.g., Weakley, 2011). Diagnostic morphology of the perianth, pertinent to the discussion of the species name (below), includes the clawed base and the expanded orbicular tepal blades with strongly undulate margins (Zomlefer, 1997). The base of each tepal has a prominent pair of yellowish green perigonal glands, a characteristic of many species of tribe Melanthieae (Zomlefer et al., 2003, 2006).

Ward (2008, 2010) presented compelling evidence that this species was first described by Thomas Walter (1788) as *Melanthium hybridum* Walter in *Flora Caroliniana*. Pursh (1813) was the first botanist to recognize the apparent priority of Walter's name for the broad-petaled *Melanthium* of the southern Appalachians and cited the later names, *M. latifolium* (Lamarck, 1797) and *M. racemosum* Michx. (Michaux, 1803), as synonyms. Although several other prominent botanists (e.g., Elliott, 1817; Nuttall, 1818; Chapman, 1860; Gleason, 1952; Radford et al., 1968; Strausbaugh & Core, 1970) also adopted Walter's name, certain issues concerning the taxonomy of this name require clarification before wider contemporary acceptance is justified: Walter did not have a herbarium, and the name *M. hybridum* has often been considered misapplied, due to presumed ambiguities in his brief Latin diagnosis, as detailed by the monographer Bodkin (Bodkin, 1978, 1979; Bodkin & Utech, 2002). Recently, Ward (2008) resolved the typification of many of the names assigned to American plants by Walter, including the neotypification of *M. hybridum*. Further, Walter's diagnosis of *M. hybridum*, which included a description of orbicular petals with undulate margins ("plicato-undulatis," Walter, 1788: 125), clearly referred to the unique tepals of the crisped bunch-flower (Fernald & Schubert, 1948; Ward, 2010).

However, Ward (2008, 2010) did not address Bodkin's (1978) main obstacle to matching Walter's diagnosis to this particular species: the adjective immaculatis (unspotted) for the glandular condition of the tepals (i.e., lacking glands), which does not accurately portray the prominent perigonal nectaries of the crisped bunch-flower. Bodkin's interpretation is evidently based on the handwritten annotations of several botanists (e.g., James MacBride and Charles Sprague Sargent; see Ward, 2010) in a reprint edition of *Flora Caroliniana* (Walter, 1946). However, the term used in the original published diagnosis (Walter, 1788: 125) is actually "mmaculatis" [sic], a typographical error for either [i]mmaculatis (unspotted) or maculatis (spotted). In the facsimile edition (Walter, 1946: 125), the printed word "mmaculatis" has been overwritten with one "m" crossed out and an "i" added to the beginning of the word (cf. Fig. 1). Fernald and Schubert (1948: 193) noted "mmaculatis" parenthetically as an "evident misprint," without further explanation. Considering his accurate description of the unique tepal shape, Walter's original intent was likely spotted (maculatis,

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157. MELANTHIUM. *Cor.* 6-petala perſiſtentia, *colorem mutantia.* *Capſulæ* apice divaricatæ.

* Petalis unguiculatis imprimis albis demum obſcuro-rubris ſeminibus *ſemi ovatis.*

virginicum 1. petalis planis maculis duabus flavis notatis, floribus plerumque hermaphroditis.

hybridum 2. petalis plicato-undulatis immaculatis, floribus maſculis et fœmineis mixtis.

monoicum 3. petalis planis, maculis 2 luteis ; floribus inferioribus maſculis majoribus, paniculis lateralibus ; ſuperioribus fœmineis racemo terminali.

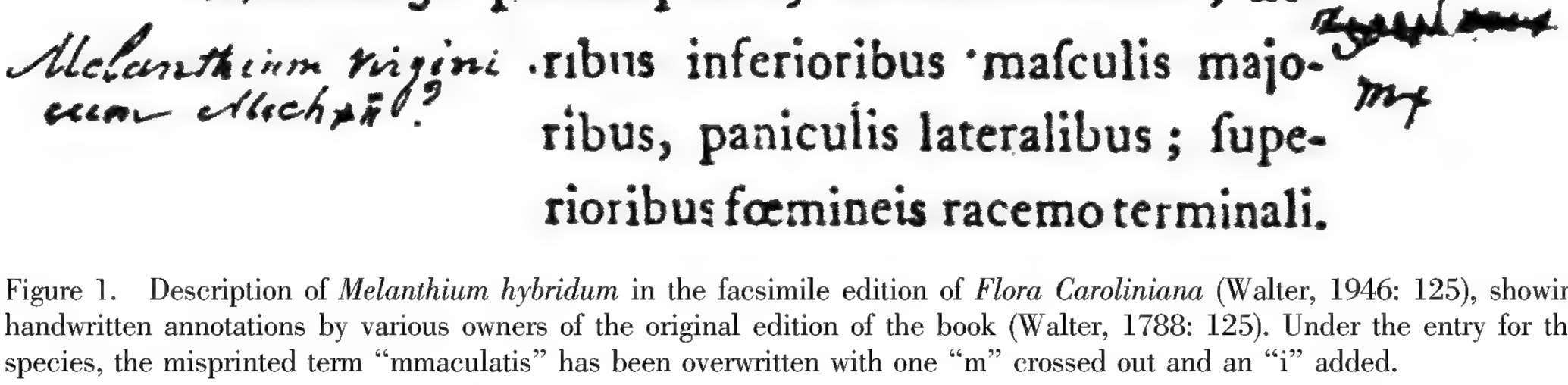

Figure 1. Description of *Melanthium hybridum* in the facsimile edition of *Flora Caroliniana* (Walter, 1946: 125), showing handwritten annotations by various owners of the original edition of the book (Walter, 1788: 125). Under the entry for this species, the misprinted term "mmaculatis" has been overwritten with one "m" crossed out and an "i" added.

with glands) and not the adjective modified by owner(s) of an original copy of *Flora Caroliniana*.

The establishment of *Melanthium hybridum* as the correct name for the crisped bunch-flower generates an unresolved nomenclatural issue, relative to the circumscription of *Melanthium* L. (two to four species) versus *Veratrum* L. (17 to 45 species). The two genera have a complex taxonomic and nomenclatural history, and *Veratrum* has been variously defined with *Melanthium* submerged totally or in part (cf. summaries in Zimmerman, 1958; Bodkin, 1978; Zomlefer et al., 2003). Recent molecular analyses show that recognition of the traditional *Melanthium* makes *Veratrum* paraphyletic, supporting a recommendation to submerge *Melanthium* within *Veratrum* s.l. (Zomlefer et al., 2003). However, although these two Linnaean generic names have equal priority (Linnaeus, 1753), Thunberg (1797) first cited *Veratrum* as the synonym of *Melanthium*, thereby establishing the priority of *Melanthium* over *Veratrum* (Art. 11.5; McNeill et al., 2012). Therefore, combinations within *Veratrum* based on *Melanthium* are valid and legitimate, but are incorrect.

A proposal (Zomlefer et al., 2010) to continue the widespread usage of *Veratrum*, which would best serve stability of nomenclature (Art. 14.2, McNeill et al., 2012), was approved by the Nomenclature Committee for Vascular Plants (Barrie, 2011; Brummitt, 2011; McNeill et al., 2011). The voted acceptance of this proposal at the Melbourne International Botanical Congress establishes the name *Veratrum* as now conserved over *Melanthium* (Barrie, 2011; Brummitt, 2011; McNeill et al., 2012). This necessitates the transfer of the name *Melanthium hybridum* to *Veratrum*, as previously attempted by the monographer Zimmerman (1958), who accepted Walter's name and circumscribed a broadly defined, monophyletic *Veratrum*. However, his recombination (Kupchan et al., 1961: 11) was not validly published (Gandhi, 2007, online), because the reference to the basionym is incomplete, lacking a citation of publication, page, and date (Art. 33.4, McNeill et al., 2012). The complete reference for this new combination is provided below, giving James Hall Zimmerman (1924–1992) credit for his studies on *Veratrum* and including recognition of the priority of Walter's name for the crisped bunch-flower (Zimmerman, 1958; Kupchan et al., 1961).

Veratrum hybridum (Walter) J. H. Zimmerman ex Zomlefer, comb. nov. Basionym: *Melanthium hybridum* Walter, Fl. Carol. 125. 1788. *Lei-*

manthium hybridum (Walter) Sweet, Hort. Brit. 429. 1826. *Zigadenus hybridus* (Walter) Endl. ex Kunth, Enum. Pl. 4: 196. 1843. TYPE: U.S.A. South Carolina: Greenville Co., W of Marietta, 12 Sep. 1989, *J. B. Nelson 8431* (neotype, designated by Ward [2008: 1281], USCH 49759 [st.], USCH 49760 [fl./fr.]).

Melanthium latifolium Desr. in Lam., Encycl. 4: 25. 1797, syn. nov. *Veratrum latifolium* (Desr. in Lam.) Zomlefer, Harvard Pap. Bot. 2(2): 161. 1997. TYPE: U.S.A. s.d., *Anonymous* [presumed *J. Frasier*] *s.n.* (holotype, P [barcode] P00562958 not seen, P-00562598 image, P [microfiche] 654/18 at GA).

Melanthium racemosum Michx., Fl. Bor.-Amer. 2: 251. 1803. TYPE: U.S.A. Carolina [North Carolina]: Yellow Mtn. [Mt. Mitchell], 23 June 1789, *A. Michaux s.n.* (holotype, P not seen, P [microfiche] 126/19 at GA; isotype, P [barcode] P00730362 not seen, P-00730362 image).

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Alpinia rugosa (Zingiberaceae), a New Species from Hainan, China

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Abstract. The new species *Alpinia rugosa* S. J. Chen & Z. Y. Chen (Zingiberaceae) is described and illustrated from Hainan, China. The new taxon is distinguished from its related species *A. kwangsiensis* T. L. Wu & S. J. Chen by having a shorter pseudostem, smaller and more pronounced rugose to the leaf blade, shorter inflorescence, absent bracteole, pink calyx, and an orange labellum with a red tinge.

Key words: *Alpinia*, China, Hainan, IUCN Red List, Zingiberaceae.

Established in 1810, *Alpinia* Roxb. is the largest genus in the Zingiberaceae and comprises ca. 230 species across tropical and subtropical Asia, Australia, and the Pacific Islands. There are 51 species, 35 of which are endemic in China (Wu & Larsen, 2000). *Alpinia* can be easily distinguished from other genera by its large herbs, terminal panicle, raceme, or spike, small or absent lateral staminodes, and often showy labellum (Larsen, 1998; Wu & Larsen, 2000).

While in the field in September 1990, Ze-Xian Li and Fu-Wu Xing (IBSC) collected an unidentified zingiberaceous plant from Mt. Diaoluoshan, Baoting County, Hainan Province, China. After studying its morphological characteristics in detail and further referring to the taxonomic literature and relevant herbarium specimens, we conclude that this plant represents a new species in *Alpinia*, which is described herein. It is known only from Hainan Island and is distinguished by its entirely wrinkled leaves, orange labellum, subulate lateral staminodes, and gamboge or deep yellow mature fruits.

Alpinia rugosa S. J. Chen & Z. Y. Chen, sp. nov. TYPE: China. Hainan: Baoting Co., Mt. Diaoluoshan [cultivated in Guangdong, at the Ginger Garden of the South China Botanical Garden], 26 Mar. 2010, *Zou Pu & Ye Yushi 01* (holotype, IBSC). Figure 1.

Species nova *Alpiniae kwangsiensi* T. L. Wu & S. J. Chen affinis, a qua praesertim foliis conspicue rugosis apice retrocurvis, bracteola nulla atque staminodiis lateralibus subulatis differt.

Pseudostems 0.5–1.2 m. Ligules coriaceous, bilobed, ca. 1 cm long, hirsute; petioles 1–5 cm, pubescent; leaf blades oblong, 23–57 × 5–8 cm, adaxially glabrous, abaxially densely pubescent, extremely rugose, base deeply cordate to overlapping, slightly oblique, margins entire and recurved, apex acuminate and recurved. Racemes erect, 7–10 × 9–26 cm, densely flowered, with 9 to 20 flowers, the entire inflorescence slightly elongate in fruit, dense yellow pubescence; bracts brown, 5–11 × 2 cm; bracteoles absent; pedicels 3–4 mm, densely pubescent. Calyx pink, tubular, 1.5–1.8 cm, split on one side, abaxially yellow hirsute, apex 2- or 3-cleft; corolla tubular, white, pubescent, ca. 1.4 cm; the 2 lateral corolla lobes 2.6–2.8 × 1.5–1.7 cm, margin ciliate, the central one ca. 3.3 × 2.1 cm; labellum orange, tinged with red, ovate, ca. 2.7–3.6 × 2.5–3.6 cm; staminodes subulate and short; fertile stamen ca. 2.3 cm, filament ca. 0.9 cm, anther ca. 1.4 cm; ovary oblong, ca. 5 mm, densely yellow hirsute, style ca. 3.7 cm, stigma cupulate. Capsule ellipsoid, 1.8–2.1 × 1.4–1.9 cm, pubescent, calyx persistent; mature fruit gamboge or intensely yellow in color. Chromosome count $2n = 48$.

Distribution and habitat. *Alpinia rugosa* is only known from Baoting County in Hainan Province, China. It has been observed in shaded wet habitats in valley forests at altitudes of ca. 600–800 m, and has been cultivated in Hawaii.

IUCN Red List category. There have been no comprehensive field surveys of populations of *Alpinia rugosa*, so this species should be classified as Data Deficient (DD), according to IUCN Red List criteria (IUCN, 2001). Further field research may provide a more precise conservation assessment in the future.

Phenology and usage. *Alpinia rugosa* has been observed in flower at the South China Botanical Garden under cultivation from March to April, with fruits from May to June. The taxon has been used for landscaping, such as ornamentals.

Discussion. *Alpinia rugosa* closely resembles *A. kwangsiensis* T. L. Wu & S. J. Chen in its oblong leaf blades, with a cordate base, bifid ligules, and erect racemes. However, the new species can be easily

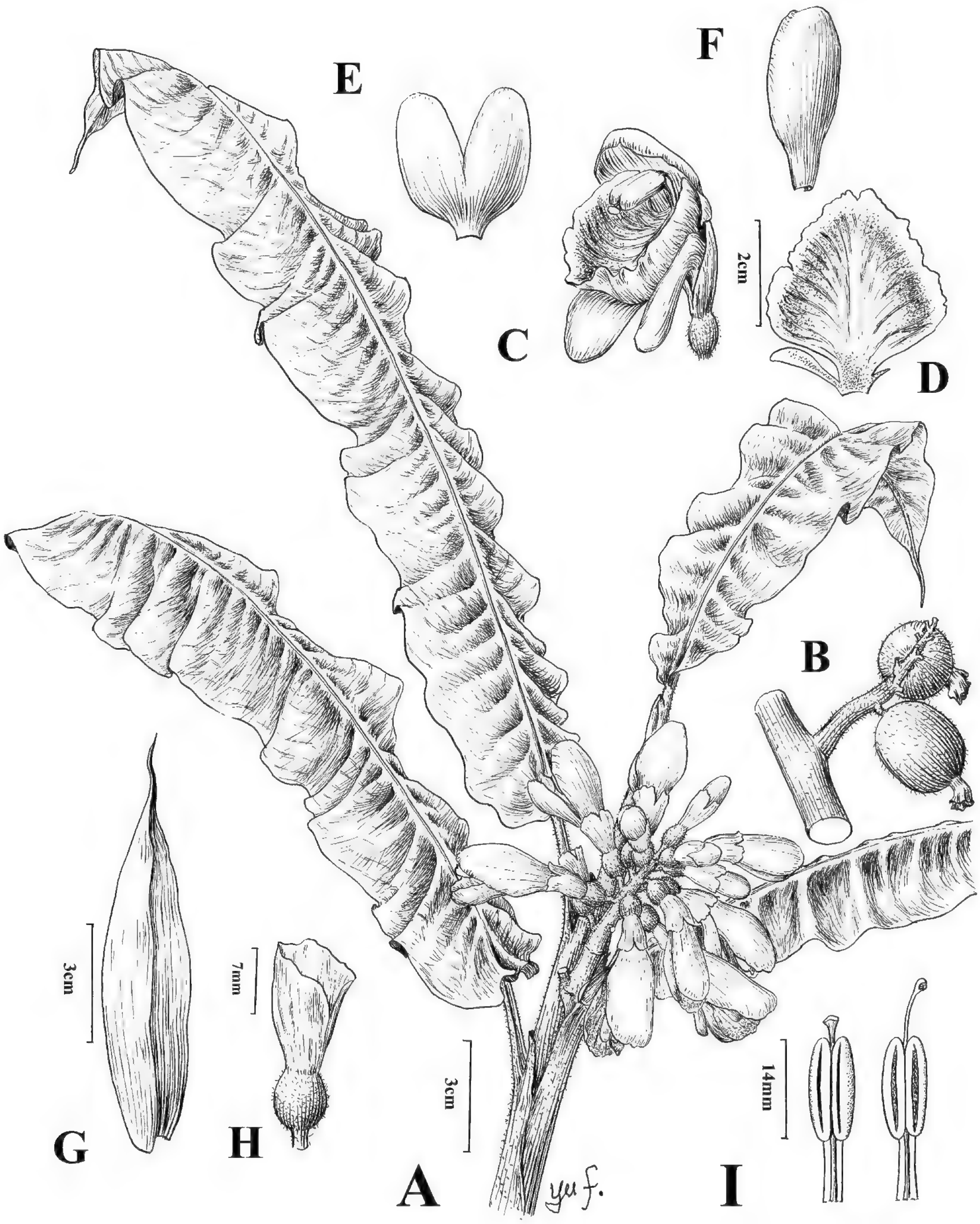

Figure 1. *Alpinia rugosa* S. J. Chen & Z. Y. Chen. —A. Flowering pseudostem. —B. Fruiting branch. —C. Flower. —D. Labellum. —E. Lateral lobes. —F. Middle lobe. —G. Bract. —H. Calyx tube and densely hirsute ovary. —I. Stamen and stigma (left: obverse view; right: inverse view). A–I drawn by Yu Feng from the paratype *Ye Yushi & Zou Pu 02* (IBSC).

distinguished from *A. kwangsiensis* by its shorter pseudostems, smaller and extremely rugose leaf blade, shorter inflorescences, absent bracteoles, and orange labellum tinged with red. Both species occur in similar wet, shaded habitats in valley forests, with *A. kwangsiensis* found from sea level to 700 m. Moreover, the new species has been collected only from Baoting County, Hainan Province, and in contrast *A. kwangsiensis* is more widely distributed in Guangdong, Guangxi, Guizhou, and Yunnan provinces. For more details, see Table 1 and Figure 1. Based on the absent bracteoles, *A. rugosa* belongs to subgenus *Probolocalyx* K. Schum. (Wu, 1981). Chromosome counts for *A. rugosa* were first reported by Chen and Huang (1996).

Paratypes. CHINA. **Guangdong:** cultivated in Ginger Garden of South China Botanical Garden, introduced from Mt. Diaoluoshan, Baoting County, Hainan Prov., 1 Apr.

Table 1. Comparison of morphological characters of *Alpinia rugosa* and *A. kwangsiensis* in China.

Characters	*A. rugosa*	*A. kwangsiensis*
Pseudostems (cm)	50–120	150–300
Leaf blades (cm)	23–57 × 5–8, oblong, extremely rugose	40–60 × 8–16, oblong-lanceolate, slightly wrinkled
Racemes (cm)	7–10	13–30
Bracteoles	absent	brown, oblong
Calyx	pink, tubular	pale purple, cylindric
Labellum	orange tinged with red	white tinged with red
Capsule	ellipsoid, pubescent, calyx persistent	globose, sparsely villous, bracteole persistent
Distribution	Baoting County, Hainan Province	Guangdong, Guangxi, Guizhou, and Yunnan provinces

2009, *Ye Yushi 4845* (IBSC), 30 Mar. 2010, *Ye Yushi & Zou Pu 02* (IBSC).

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NOVON

A New Species of *Amaranthus* (Amaranthaceae) from Salta, Argentina

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ABSTRACT. *Amaranthus pedersenianus* N. Bayón & C. Peláez (Amaranthaceae) is a new Argentinian species of *Amaranthus* L. subg. *Albersia* (Kunth) Gren. & Godr. and is described and illustrated from the province of Salta. It is found in Andean puna and prepuna in both Salta and Jujuy provinces at altitudes between 2800 and 3775 m. *Amaranthus pedersenianus* is similar to *A. cardenasianus* Hunz., *A. hunzikeri* N. Bayón, *A. kloosianus* Hunz., *A. squamulatus* (Andersson) B. L. Rob., and *A. urceolatus* Benth. by its urceolate pistillate flowers with five sepals. The new taxon differs by its ascendant or erect habit, height of 5–20 cm, presence of leafless, short terminal inflorescences, flowers with usually four or five stamens, and dehiscent fruits.

Key words: Amaranthaceae, *Amaranthus*, Argentina, IUCN Red List.

The genus *Amaranthus* L. includes around 70 species: 10 are dioecious (Sauer, 1955) and the other 60 are monoecious (Costea & DeMason, 2001; Costea et al., 2001a, 2001b; Mosyakin & Robertson, 2003; Palmer, 2009). More than 40 species of *Amaranthus* are mainly distributed in tropical and warm temperate regions of the Americas, but several species are also present in Australia, Africa, and Eurasia.

The new species belongs to *Amaranthus* subg. *Albersia* (Kunth) Gren. & Godr. This is a subgenus of monoecious, mainly ascendant plants (sometimes erect), with dichasia arranged in axillary clusters and terminal spikelike inflorescences, as well as membranous bracts and bracteoles.

Amaranthus pedersenianus N. Bayón & C. Peláez, sp. nov. TYPE: Argentina. Salta: Dpto. Cachi, a 46 km de Cachi, camino a Salta, 19 mar. 1972, 3050 m, *A. Krapovickas, V. Maruñak, O. Oliva & H. Pueyo 21991* (holotype, CTES). Figure 1.

Haec species inter congeneros austroamericanos flores pistillatos urceolatos gerentes quoad habitum adscendentem erectumve etiam fructum dehiscentem *Amarantho cardenasiano* Hunz. similis, sed ab eo statura minore, foliis anguste ellipticis vel ellipticis atque inflorescentiis axillaribus glomerulatis et terminalibus spiciformibus brevibus distinguitur.

Herbs, probably annual, monoecious, usually ascendant, sometimes erect; taproot to 15 cm, rootlets few; stems 3 to 5, unbranched, glabrous, 5–20 cm tall, 0.5–4.5 mm thick at base, sometimes slender at apex, internodes 0.5–4 cm. Leaves similar in length throughout; petiole 5–12 mm, shorter than the lamina; lamina narrowly elliptic to elliptic, 1.9–3.3 × 0.4–1.4 cm, glabrous, dark green on both sides, attenuate at base, obtuse or rounded at apex with mucro 0.3–1 mm, margins crisped, veins raised abaxially. Inflorescences whitish green, sometimes with little pink spots, flowers in rounded axillary clusters of 0.5–1 cm diam., clusters solitary or crowded in terminal

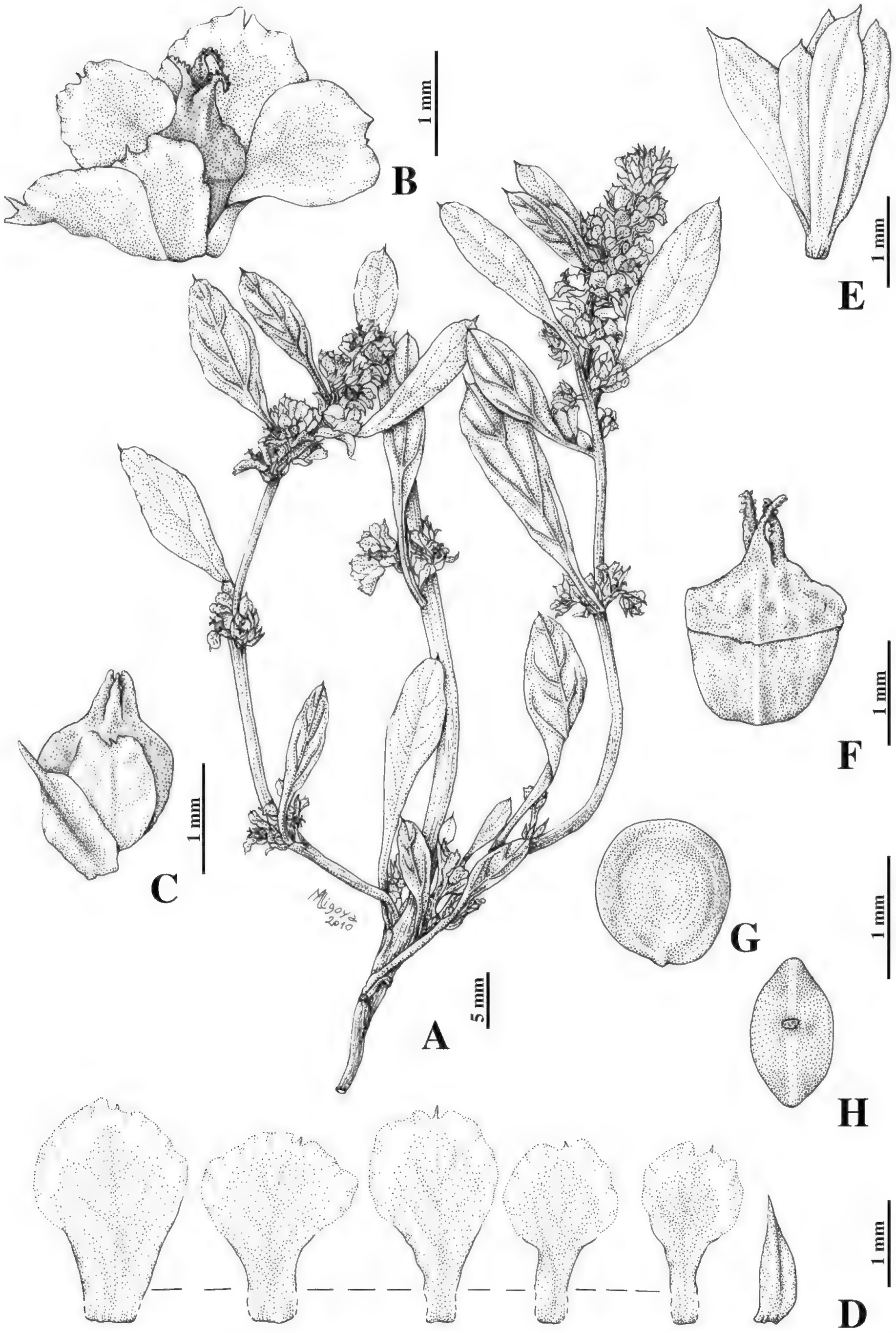

Figure 1. *Amaranthus pedersenianus* N. Bayón & C. Peláez. —A. Fertile habit. —B. Pistillate flower. —C. Pistillate flower with bract and only one sepal. —D. Sepals and bract (at far right) dissected from pistillate flower. —E. Staminate flower. —F. Fruit. —G. Seed, lateral view. —H. Seed, hilar view. Drawn from the holotype *A. Krapovickas, V. Maruñak, O. Oliva & H. Pueyo 21991* (CTES).

spikelike inflorescences, 1.5–4 × 0.5–0.7 cm; bracts and bracteoles narrowly ovate to ovate, persistent, shorter than the sepals, 0.9–2.5 × 0.4–1.1 mm, membranous, green along midvein, mucro 0.2–0.5 mm. Flowers of both sexes intermixed: staminate flowers 2–2.9 × 0.8–1.9 mm, with (3)4 or 5 narrowly elliptic sepals, 1.9–3.3 × 0.5–1 mm, whitish with green or light brown midvein, obtuse or subacute, sometimes mucronulate, scarious; stamens (3)4 or 5, filament 1–1.1 mm, anther 0.9–1 mm; pistillate flowers 2.2–3.2 × 2.5–4 mm distally, longer than mature fruit, urceolate with (3)4 or 5 sepals, sepals slightly swollen and joined 0.5 mm at base, obovate to spatulate, 2–4 mm, lamina expanded to 0.9–2.3 mm wide near tip, rounded to truncate, narrowed at base to 0.2–0.7 mm wide, overlapping and bent outward in upper half, scarious marginally and herbaceous centrally, usually notched apically, midvein profusely divided with many green branches, unequal; stigmas 3, narrow, usually bent outward or erect, 0.3–0.8 mm; rarely scattered among normal flowers, pistillate flowers may lack sepals or have only 1 to 3 ovate or elliptic, smaller sepals, 0.8–1.5 × 0.25–1 mm, shorter than the pistil. Fruit circumscissile, 1.1–2 × 1.2–1.5 mm (including stigmas), dark green; lid rugose, urn or bottom portion of fruit smooth or rugose; line of dehiscence at mid-portion of fruit; seeds 1–1.5 × 1–1.3 mm, dark brown to black, smooth and glossy centrally on the convex surfaces, margin minutely granular and dull.

Distribution, habitat, and phenology. *Amaranthus pedersenianus* has been collected from the Andes of the northwestern province of Salta (Argentina), where it was found at altitudes from 2800 to 3775 m in the puneña and prepuneña phytogeographic provinces. The new species has also been collected from adjacent Jujuy. According to the label of one paratype (*Cabrera 8697*), it has the vernacular name of "Ataco Silvestre." All the type material was collected from January to March with flowers and mature fruits.

IUCN Red List category. Since this species is known only from the limited type material, it is difficult to evaluate its distribution and population status. Therefore, it is not possible to assess its risk of extinction. For the moment, *Amaranthus pedersenianus* should be included in the category Data Deficient (DD), according to IUCN Red List criteria (IUCN, 2001).

Etymology. The specific epithet honors Troels Myndel Pedersen (1916–2000), a Danish botanist who lived in Argentina and studied the family Amaranthaceae widely.

Relationships. *Amaranthus pedersenianus* is similar to five South American species with urceolate pistillate flowers, which can have five sepals. The following taxonomic key distinguishes these species.

KEY TO FIVE SPECIES IN *AMARANTHUS* SUBG. *ALBERSIA* IN ANDEAN ARGENTINA

1a. Fruits indehiscent 2
2a. Pistillate flowers 3.5–5 mm wide distally .... *A. squamulatus* (Andersson) B. L. Rob.
2b. Pistillate flowers up to 2.5 mm wide distally.
3a. Leaves narrowly elliptic; staminate flowers with 5 stamens ..... *A. kloosianus* Hunz.
3b. Leaves elliptic to ovate; staminate flowers with (2)3 stamens ..... *A. urceolatus* Benth.
1b. Fruits dehiscent 4
4a. Plants prostrate to decumbent, < 5 cm high; flowers assembled in axillary clusters and crowded in leafy terminal spikelike inflorescence; stamens (2)3 or 4 ..... *A. hunzikeri* N. Bayón
4b. Plants ascendant or erect, > 5 cm high; flowers assembled in axillary clusters and leafless terminal spikelike inflorescences; stamens (3)4 or 5 5
5a. Plants 70–100 cm high; inflorescences mainly terminal, ca. 12 × 3 cm; stamens 5; leaves ovate to rhombic, 4–8 cm ..... *A. cardenasianus* Hunz.
5b. Plants 5–20 cm high; inflorescences axillary clusters 0.5–1 cm diam. and terminal spikelike, 1.5–4 × 0.5–0.7 cm; stamens (3)4 or 5; leaves narrowly elliptic to elliptic, 2.5–4.2 cm .... *A. pedersenianus* N. Bayón & C. Peláez

Paratypes. ARGENTINA. **Jujuy:** Dpto. Humahuaca, empalme a Iturbe, 20 ene. 1976, *A. L. Cabrera, S. Arroyo, N. M. Bacigalupo, E. G. Nicora & E. A. Ulibarri 27386* (SI). **Salta:** Dpto. Cachi, betw. Payogasta & Tin-Tin, 27 Feb. 1965, 2800 m, *J. H. Hunziker 8073* (CORD); Dpto. Rosario de Lerma, Santa Rosa de Tastil, 3250 m, 28 Feb. 2005, *G. E. Barboza, A. M. Matesevach, E. M. Filippa, C. Peláez & E. Marini 1453, 1455, 1455 bis* (CORD); Dpto. La Poma, Tipán, Campo de la Paciencia, 3600 m, 12 Feb. 1945, "Ataco Silvestre," *A. L. Cabrera 8697* (LP); Dpto. Los Andes, San Antonio de los Cobres, 3775 m, 7 Feb. 1946, *A. L. Cabrera 8971* (LP).

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Jacquemontia macrocalyx (Convolvulaceae), a New Species Endemic to the Espinhaço Range, Brazil

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Abstract. *Jacquemontia macrocalyx* Buril (Convolvulaceae) is described from Morro do Chapéu, Cadeia do Espinhaço, Bahia, Brazil. The new species is related to *J. heterantha* (Nees & Mart.) Hallier f., but is distinguished by its fruticose habit and larger sepals. Its conservation status is assessed as Endangered (EN), according to IUCN Red List criteria.

Resumo. *Jacquemontia macrocalyx* Buril (Convolvulaceae) é descrita como endêmica do Parque Estadual de Morro do Chapéu, Cadeia do Espinhaço, Bahia, Brasil. A nova espécie é similar a *J. heterantha* (Nees & Mart.) Hallier f., mas se distingue pelo hábito arbustivo e sépalas maiores. O seu status de conservação é considerado como EN ou em risco de extinção, de acordo com os critérios da IUCN.

Key words: *Aniseia*, Bahia, Brazil, Chapada Diamantina, Convolvulaceae, IUCN Red List, *Jacquemontia*.

The Espinhaço Range is the second largest complex of mountains in Brazil, extending from the eastern state of Bahia inland through Minas Gerais, with many stretches above 700 m in altitude (Kamino et al., 2008). This is an area of conjunction among vegetation types of caatinga, cerrado, and Mata Atlântica, and presents a peculiar flora. Many microendemic species occur along the range, and a low similarity in the flora of different areas, sometimes even of adjacent areas, is reported (Rapini et al., 2008). Recently, several new species of Convolvulaceae have been described from the Espinhaço Range (Simão-Bianchini, 1999; Simão-Bianchini & Pirani, 2005; Krapovickas, 2009; Buril & Alves, 2011), with four of them belonging to *Jacquemontia* Choisy.

Jacquemontia (Convolvulaceae), distributed primarily in the Neotropics, is one of the largest genera of Convolvulaceae with nearly 120 species (Staples & Brummitt, 2007). It occurs mostly in open vegetation types, and the Brazilian semi-arid region can be considered one of the centers of diversity, with more than 30 species, many of which are endemic (Bianchini & Ferreira, 2012).

Jacquemontia was established by Choisy in 1834 based on species described under *Convolvulus* L. and *Ipomoea* L. He defined the genus, based on the shape of stigmatic lobes, the presence of stellate trichomes (vs. simple ones in all other related genus), and 8-valvate capsules (vs. 4-valvate as often seen in *Convolvulus/Ipomoea*). According to Robertson (1971), the genus can be recognized by: (1) the stellate or T-shaped trichomes; (2) the essentially glabrous to ciliate corolla on the apex of the mid-petaline line; (3) the 3-aggrecolpate pollen; (4) the glabrous, 2-locular, 4-ovulate ovaries; (5) a single style, with two, flattened, oval lobes; (6) the capsules usually with (two)four(eight) valves; and (7) glabrous seeds that are often narrowly winged along the outer margin.

Jacquemontia macrocalyx Buril, sp. nov. TYPE: Brazil. Bahia: Parque Estadual Morro do Chapéu, Lagedo Bordado, 11°16′20″S, 41°05′05″W, 736 m, 6 Feb. 2011, *B. S. Amorim, K. Mendes & D. Moura 752* (holotype, UFP; isotypes, MO, SP). Figures 1, 2.

Species nova *Jacquemontiae heteranthae* (Nees. & Mart.) Hallier f. affinis, sed ab ea habitu fruticoso atque sepalis externis multo latioribus et longioribus differt.

Shrub 0.4–1.5 m tall, woody at base, velutinous, stellate trichomes of two sizes, 4- or 5-rayed, the shorter ca. 0.3 mm more dense, the longer ca. 0.6 mm sparsely distributed; latex absent; stem internodes 1.7–3.2 cm long. Leaf blades 2.5–3.6 × 1.7–2.2 cm, papyraceous, entire, ovate to broadly elliptic, base rounded to subcordate, apex apiculate to acuminate, green to grayish, yellowish when dried, velutinous, corrugated, but apparent only in fresh material; venation campto-

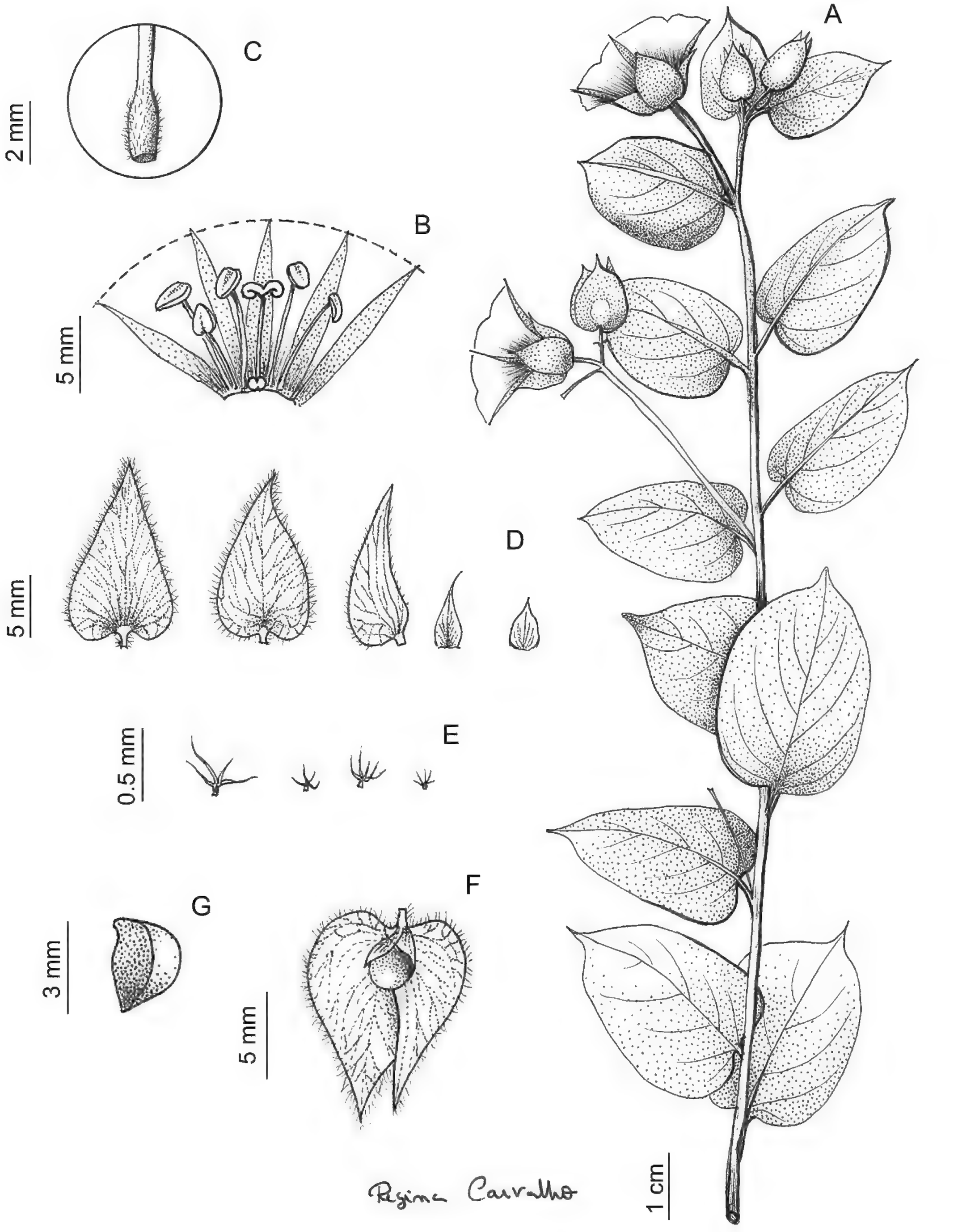

Figure 1. *Jacquemontia macrocalyx* Buril. —A. Fertile habit. —B. Dissection of an open flower. —C. Detail of stamen showing the pilose filament base. —D. Sepals, from left to right, proceeding from outer to inner positions. —E. Stellate trichomes, 4- or 5-rayed. —F. Capsular fruit, subtended by persistent bracts. —G. Seed. Drawn from the holotype *B. S. Amorim, K. Mendes & D. Moura 752* (UFP).

Table 1. Comparison of morphological characters and geographic distribution between *Jacquemontia macrocalyx* and related species.

	J. bifida	*J. gracillima*	*J. heterantha*	*J. macrocalyx*
Habit	vines	erect to climbing herbs	vines	shrubs
Leaf blade	ovate	oblong to elliptic	ovate	ovate to broadly elliptic
Inflorescence	umbelliform, 7- to 25-flowered	monochasial, similar to racemose, 4(2 to 5)-flowered	monochasial, similar to racemose, (1)2(3 or 4)-flowered	monochasial or dichasial cymes, 2- or 3-flowered
Outer sepal shape	ovate to rotund	deltoid	ovate to deltoid	ovate
Outer sepal size	0.45–1.3 × 0.35–0.8 cm	5–6 × 4.4–5.5 mm	5.5–7.5 × 4.5–6.5 mm	1.2–1.8 × 0.8–1.5 cm
Distribution	Brazil (from Ceará to Rio de Janeiro)	Brazil (from Amazonas to Pernambuco), Guyana, Venezuela, Panama	Brazil (from Bahia to Mato Grosso do Sul)	Brazil (Bahia)

dromous, with 5 pairs of secondary veins; petiole 4–6 mm. Inflorescences as monochasial or dichasial cymes, 2- or 3-flowered; peduncles 0.5–4.5 cm, axillary, when terminal very short, velutinous; bracts 2, ca. 5 mm, linear, velutinous; sepals membranous, entire, unequal, the outer two 1.2–1.8 × 0.8–1.5 cm, ovate to deltoid, rarely lanceolate, base cordate, apex acuminate to acute, pubescent, intermediate one 1–1.4 × 0.3–0.4 cm, asymmetric, inner two 0.3–0.5 × 0.2–0.25 cm, entire, ovate to lanceolate, base rounded, apex acuminate, pubescent; corolla 1.4–1.5 cm long, funnelform, apex of midpetaline line ciliate, lilac with the tube light pink; stamens ca. 8 mm, filaments pilose on the base, anthers ovoid, white; nectary absent; ovary ca. 0.5 mm, oblong, glabrous, 2-locular, 2 ovules per locule; style 0.5–1 cm, stigmatic lobes ca. 0.5 mm,

Figure 2. *Jacquemontia macrocalyx*. —A. Plant habit and habitat. —B. Axillary inflorescences showing two flowers in lateral view. Arrows indicate the conspicuous calyces. —C. Flower, as seen from above. Photographs of the holotype and type locality (*B. S. Amorim, K. Mendes & D. Moura 752* [UFP]). Scale bars in A–C = 1 cm.

ovate to flattened, white. Capsule 5 × 4 mm, 8-valvate, oblong, subtended by persistent bracts; seeds 1 or 2, ca. 3–3.5 mm, trigonal, glabrous, with the lateral ridge lacking (Fig. 1).

Distribution and habitat. *Jacquemontia macrocalyx* is a shrub from the rocky fields of Bahia, known only from the State Park of Morro do Chapéu, located in the Serra do Espinhaço. It is found among rocks at an average altitude of 700 m. In the field, the leaves are corrugated, a feature that is not distinguishable in dried specimens.

IUCN Red List category. This species is assessed here as Endangered (EN), according to IUCN (2001) Red List criteria. This is assessed as B1, with an area of occupancy estimated to be less than 5000 km^2, and the population size is estimated to number fewer than 250 mature individuals, as known to occur in only two locations. The new species is known from only two localities in Bahia, Brazil.

Phenology. Flowers and fruits of *Jacquemontia macrocalyx* were collected in January and February.

Etymology. The Latin epithet *macrocalyx* refers to the size of the outer sepals, which are longer (1.2–1.8 cm) than in other species of *Jacquemontia* which, in general, do not exceed ca. 6 mm.

Taxonomic affinities. Morphologically, the new species described here may be related to a group of species that have been previously placed in the genus *Aniseia* Choisy. Those are *Jacquemontia gracillima* (Choisy) Hallier f. (basionym: *A. gracillima* Choisy), *J. bifida* (Vell.) Hallier (basionym: *Convolvulus bifidus* Vell.), and *J. heterantha* (Nees & Mart.) Hallier f. (synonym: *A. heterantha* Choisy). All of them share the cordate sepals as a remarkable characteristic, present in many actual *Aniseia*. However, these species have been transferred to *Jacquemontia*, mainly by the presence of stellate trichomes and the oval-flattened stigmatic lobes.

Krapovickas (2009) compared *Jacquemontia estrellensis* Krapov. with this group of species because of the cordate bracts. Since the sepals are hidden by the bracts, these cordate structures stand out on the inflorescence arrangement. However, the sepals are rounded to truncate and are not directly comparable to the cordate ones present in *J. macrocalyx*.

Jacquemontia gracillima is distinguished by the leaves oblong to elliptic, instead of ovate, as is found in *J. macrocalyx*, *J. heterantha*, and *J. bifida*. In addition, the outer sepals are often deltoid instead of ovate. While the new species and *J. heterantha* present 2- or 3-flowered inflorescences, *J. bifida* presents umbelliform inflorescences with at least seven flowers. Finally, in relation to *J. heterantha*, even though the sepal shape and inflorescences are similar, this is clearly distinguished by the vining habit and by the smaller sepals ca. 5 mm long (Table 1).

Paratype. BRAZIL. **Bahia:** Mun. Morro do Chapéu, Lages, on rd. of Feijão, on way to Ierecê, 11°29′52″S, 41°19′52″W, 30 Jan. 2003 (fl., fr.), *F. França 4103, S. Atkins, B. M. da Silva & M. E. R. Junqueira* (HUEFS).

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Two New Species of *Stereospermum* (Bignoniaceae) from Madagascar

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ABSTRACT. A recent review of the Malagasy Bignoniaceae for the Catalogue of the Vascular Plants of Madagascar has led to the discovery of two new species in the genus *Stereospermum* Cham.: *S. gentryi* Callm., Phillipson & G. E. Schatz and *S. randrianaivoi* Callm., Phillipson & G. E. Schatz. *Stereospermum gentryi* is unique in having leaflets spotted with red glands that give a reddish color when dry, and a long, lax, paniculate inflorescence bearing flowers with large corollas that are red-purple inside the mouth and throat. *Stereospermum randrianaivoi* can be distinguished by its usually 3-foliolate leaves with thick, coriaceous leaflets that are discolorous, with the adaxial surface drying pinkish green and the upper surface a dull gray-green, and shiny in vivo. Both of the new species are provided with illustrations, a discussion of their morphological affinities, and a conservation threat analysis based on the IUCN Red List Criteria.

RÉSUMÉ. Une révision récente de la famille des Bignoniaceae pour le Catalogue des plantes de Madagascar nous permets de découvrir deux nouvelles espèces dans le genre *Stereospermum* Cham.: *S. gentryi* Callm., Phillipson & G. E. Schatz and *S. randrianaivoi* Callm., Phillipson & G. E. Schatz. *Stereospermum gentryi* est unique possédant des folioles à limbe tacheté de glandes rouges donnant un aspect rougeâtre sur le sec et une longue et diffuse inflorescence portant des fleurs a large corolles dont l'intérieur de la gorge et de la bouche est rouge pourpre. *Stereospermum randrianaivoi* peut être distingué par ses feuilles généralement à 3-folioles, son limbe coriace, épais, discolore qui sèche de façon rosâtre (brillant in vivo). Les deux nouvelles espèces sont décrites avec des illustrations, une discussion sur leurs affinités morphologiques ainsi que l'évaluation préliminaire du statut de conservation suivant les critères de l'UICN.

Key words: Bignoniaceae, IUCN Red List, Madagascar, *Stereospermum*.

Madagascar is the second largest center of Bignoniaceae diversity in the world after South America, with ca. 80 currently accepted species (and numerous varieties) in nine genera (Perrier de la Bâthie, 1938a, 1938b; Capuron, 1960, 1970; Gentry, 1977; Zjhra, 2006). A recent review of the Malagasy Bignoniaceae for the Catalogue of the Vascular Plants of Madagascar (<http://www.efloras.org/madagascar>) has enabled us to refine taxon delimitations and has led to the discovery of new species in other genera in the family, including *Colea* Bojer ex Meisn. (Callmander & Phillipson, 2012), *Ophiocolea* H. Perrier (Callmander et al., 2011), and *Rhodocolea* Baill. (Callmander & Phillipson, 2011).

Stereospermum Cham. is distributed from Africa (four species) and Madagascar (12 spp., of which two are described in this article), to southern and southeastern Asia (four spp.). The genus can be recognized easily by its flowers with a narrowly cylindric corolla tube and its cylindric, podlike fruit with a bony seed chamber possessing alternating deep cavities in which the seeds are lodged (Schatz, 2001). The high level of species diversity in Madagascar corresponds to considerable morphological diversity, with the genus distributed throughout much of the country and occurring in varied habitats and on different substrates. Certain species are quite

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widespread, notably *S. euphorioides* DC., while others are locally endemic; however, the greatest species diversity is in the dry forests of the west and north, and the sub-arid forests and thicket of the southwest. The distribution ranges of several species overlap and we concur with previous botanists who have observed intermediate individuals at several localities in Madagascar that they considered to be the result of hybridization. The existence of intermediates has rendered species limits in *Stereospermum* difficult to determine, and we suggest that introgressive hybridization may be a likely cause of the variability that is found in certain species. In this article, we provide descriptions of two highly distinct new species of *Stereospermum*. One of the new species is known only from a single locality in the southeast of Madagascar rather isolated from known subpopulations of any other species, and its morphology is very distinct from that of all other known species. The second species is also morphologically distinct, it is confined to the dry north, and it is probably closely related to *S. boivinii* (Baill.) H. Perrier and *S. undatum* H. Perrier, which also both occur in this area. For the two new species, we provide drawings and preliminary IUCN Red List assessments, which have proven valuable for ongoing conservation efforts (see Callmander et al., 2007). We believe that other undescribed species are present in Madagascar, but currently the available material is inadequate to delimit them adequately, and work on the genus is ongoing.

1. Stereospermum gentryi Callm., Phillipson & G. E. Schatz, sp. nov. TYPE: Madagascar. Toliara: Anosy, Andohahela RN, Parcelle 1, 33 km N on rd. to Ranomafana from Rte. Nationale, 24°45′10″S, 46°51′15″E, 480 m, 24 Mar. 1992 (fl.), *P. B. Phillipson, R. A. Clement & G. Rafamantanantsoa 3979* (holotype, MO [MO-021570]; isotypes, K, MO [MO-021586], P [P00730625], TAN). Figure 1.

Haec species a congeneris madagascariensibus foliolis ad minimum 21 lamina adaxialiter glandulis rubris punctata in sicco rubescente, inflorescentia longa laxa paniculata atque corolla grandi fauce oreque intus rubropurpureis distinguitur.

Tree to 10 m with spreading branches. Leaves imparipinnate, opposite, 55 × 35 cm (including petiole); petiole 9–11 cm, ca. 0.4–0.5 cm diam., pubescent, brown-red; leaflets at least 21, lanceolate, (10–)15–17 × 3–5 cm, thin, soft, with rusty indument when young, discolorous, base attenuate, apex acuminate, acumen ca. 1 cm, margins entire, primary and secondary veins prominent on the adaxial surface, with white long hairs; adaxial surface densely spotted with red glands; abaxial surface puberulent, dark green when dry; petiolule 0.2–0.4 cm (basal leaflets) to 2 cm (terminal leaflets). Fertile branches producing solitary inflorescences at alternate nodes; inflorescence a long, lax panicle (ca. 20–30 cm), bearing 14 to 16 flowers, the leaf subtending the inflorescence about half the length of the opposing leaf and with about half as many leaflets, which are about half the length and width of the leaflets of the opposing leaf; inflorescence branches and flowers subtended by filiform bracts up to 2.5 cm long, with a rusty indument; pedicel ca. 15 mm; calyx tubular, 15 mm, with red glands outside; corolla trumpet-shaped, 70–80 × 4–4.5 mm, white tinged pink outside, shading to pale yellow at the base with minute red-purple spots, the throat and mouth red-purple inside, the 5 lobes all on the proximal side, 20 mm deep, sparsely covered with short white hairs outside; stamens 38 mm included within the corolla tube; ovary with peltate style, 35 mm. Fruit unknown.

Distribution and habitat. *Stereospermum gentryi* is endemic to the evergreen humid forests near Tolagnaro, in southeastern Madagascar (Fig. 2) at elevations between 300 and 700 m.s.m.

IUCN Red List category. *Stereospermum gentryi* is known only from three collections in very close proximity to one another in the humid forest of Andohahela National Park (parcel 1). There is currently no threat on this forest, and therefore in the absence of additional data on population size, the most appropriate preliminary assessment is to assign the new taxon the category of Least Concern (LC), according to IUCN criteria (2001).

Phenology. Flowering material of *Stereospermum gentryi* has been collected in January, March, and April. No fruiting specimens have yet been observed.

Etymology. This species is named in honor of Alwyn H. Gentry (1945–1993) who already recognized this species as new, having annotated a sheet of the type we have chosen with the unpublished name "*Colea cava*." Al Gentry was a Bignoniaceae specialist who worked mainly in the Neotropics but visited Madagascar in 1974, 1985, and 1988, where he made more than 1300 collections and undertook ecological plot samples at several localities as part of a global data set (Phillips & Miller, 2002). He collected many Bignoniaceae in Madagascar, but not *Stereospermum gentryi*.

Figure 1. *Stereospermum gentryi* Callm., Phillipson & G. E. Schatz. —A. Fertile branching with inflorescence. —B. Detail of a leaf. —C. Ventral view of a flower. —D. Dorsal view of a flower. Drawn from isotype *P. B. Phillipson, R. A. Clement & G. Rafamantanantsoa 3479* (TAN). Scale bars: A = 2 cm; B–D = 1 cm.

Observations. *Stereospermum gentryi* is distinguished from other Malagasy *Stereospermum* by its leaves with 21 leaflets or more, with the lamina adaxially spotted with red glands giving a reddish color when dry, and with a reddish brown indument on both blade surfaces. Also distinctive are the large trumpet-shaped corollas (70–80 mm long) with the throat and mouth red-purple inside, the tube

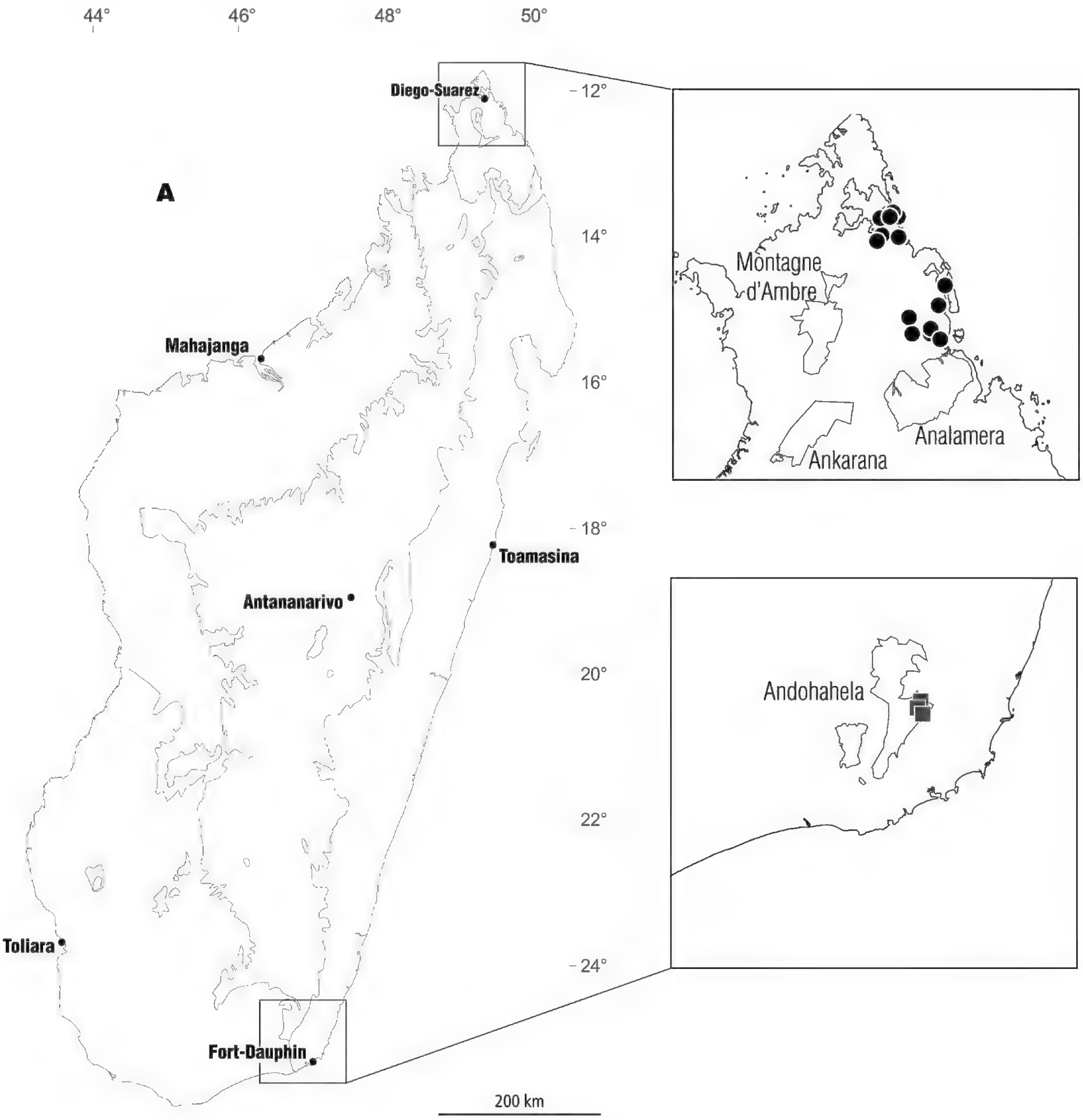

Figure 2. Distributions of the two new species of *Stereospermum* mapped on the bioclimatic zones of Madagascar (after Cornet, 1974; see Schatz, 2000): *S. gentryi* Callm., Phillipson & G. E. Schatz (squares) and *S. randrianaivoi* Callm., Phillipson & G. E. Schatz (circles).

expanding gradually to the mouth, and the long, lax paniculate inflorescence (ca. 20–30 cm long), quite unlike those of any other species in the genus, which are mostly white, smaller (under 60 mm long), narrowly tubular and expanding abruptly at the mouth, and borne in a smaller inflorescence. In Madagascar, only a single species of *Stereospermum* has larger flowers: *S. longiflorum* Capuron. It is endemic to dry forest of the extreme north, the flowers are white, and the inflorescence is highly reduced.

Paratypes. MADAGASCAR. **Toliara Prov.:** Andohahela RN, E of Ifarantsa–Enakara Ambony Rd., 24°46′S, 46°51′E, 26 Apr. 1988 (fl.), *A. J. M. Leeuwenberg, J. Floret, P. P. Lowry & R. Rajemisa 13962* (MO, P, WAG); Anosy, Col du Maningotry, 24°44′S, 46°51′E, 30 Jan. 1990 (fl.), *R. Rabevohitra 2253* (MO, P, TAN).

2. **Stereospermum randrianaivoi** Callm., Phillipson & G. E. Schatz, sp. nov. TYPE: Madagascar. Antsiranana Prov.: forêt de Sahafary, [12°34′S, 049°26′E], [50 m], 10 Dec. 1952 (fl. & fr.), *Service Forestier 6285* (holotype, P [P00730636]; isotypes, G [G00303500], MO [MO-097472], MO [MO-2160847], P [P00730638], TEF). Figure 3.

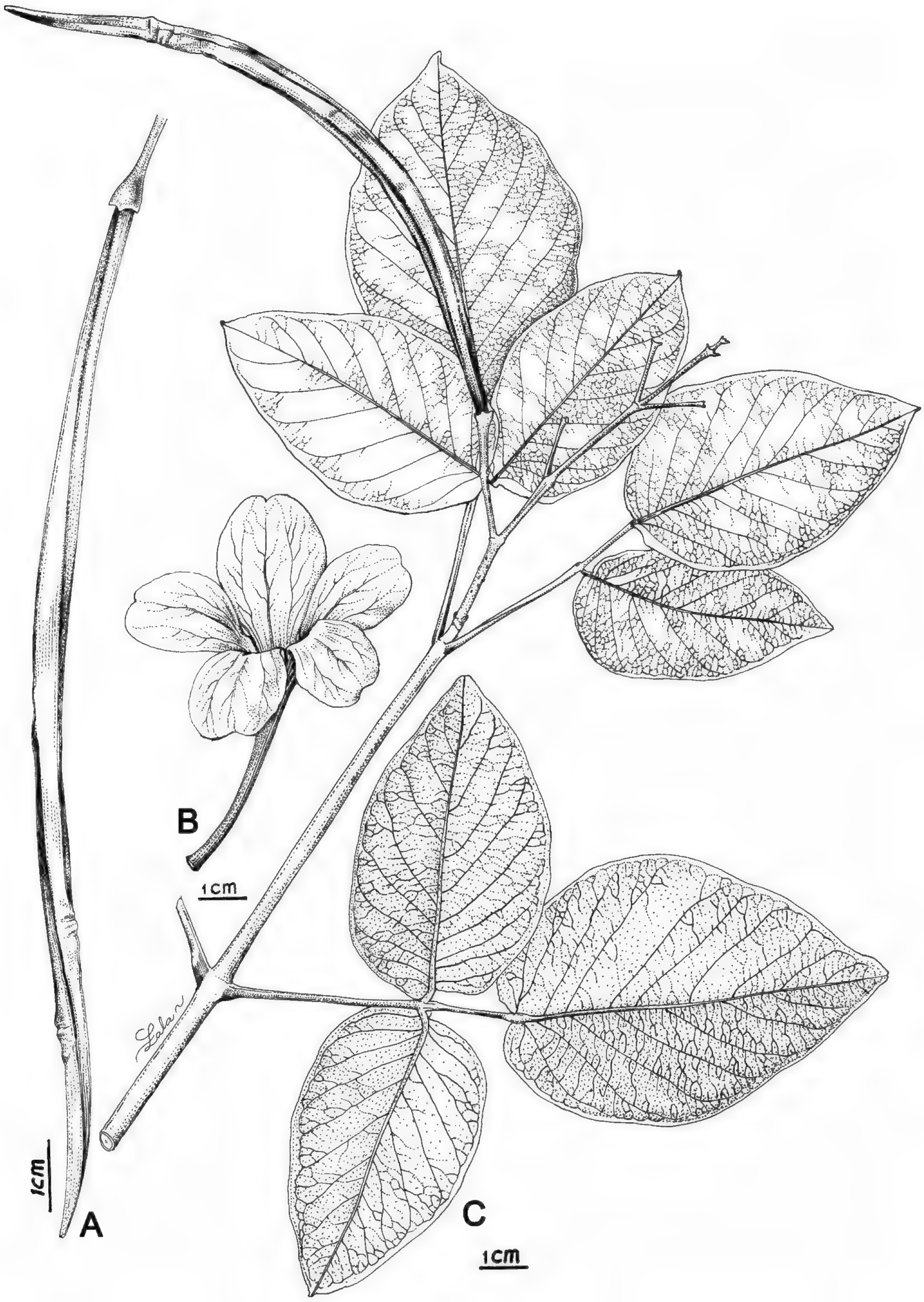

Figure 3. *Stereospermum randrianaivoi* Callm., Phillipson & G. E. Schatz. —A. Fruit. —B. Flower. —C. Fruiting branch. Sources: A, *M. Bardot-Vaucoulon 1392* (P); B, C, *J. Razafitsalama & R. Ludovic 21* (TAN). Scale bars: A–C = 1 cm.

Haec species a congeneris madagascariensibus foliolis plerumque 3, raro 1 vel 5, lamina coriacea crassa discolori in vivo nitida in sicco adaxialiter subroseo-viridi, venulis tertiariis abaxialiter reticulum densum puberulum formantibus atque corolla tubulari alba lobis patentibus trichomatibus brevibus albis sparsim vestitis distinguitur.

Treelet or tree 3–10 m. Leaves usually 3-foliolate, rarely 5-foliolate, occasionally simple leaves also present, opposite, 15–17 × 12–15 cm (including petiole); petiole 3–6 cm, ca. 0.2 cm diam., puberulent; leaflets subrotund to ovate or obovate,

(4–)5–8(–10) × (2–)3–7(–11) cm, lateral leaflets generally smaller than the terminal one, coriaceous, thick, discolorous; base variable, cuneate to cordate; apex rounded to acute; margin entire; all veins prominent on the adaxial surface with tertiary veins forming a dense pubescent reticulum; abaxial surface white puberulent, drying pinkish green (shiny in vivo); petiolule 2.5 cm (terminal leaflets) to 0.3–0.5 cm (lateral above leaflets). Inflorescence a short panicle, 4–5 cm, with 6 to 8 flowers and glabrous axes; pedicels 20–35 mm; calyx cupuliform, glabrous, 18–22 mm; corolla tubular, 50–60 × 4–4.5 mm, white (black when dried), with 5 spreading lobes, sparsely white puberulent; tube 30 × 2–4 mm, straight; lobes ovoid, longitudinally plicate, spreading, ca. 20(–25) × 15(–25) mm; stamens ca. 20 mm; style 12 mm, stigma laterally flattened. Fruit a dehiscent pod, 10–17 × 0.5–0.8 cm, brownish gray when dry.

Distribution and habitat. *Stereospermum randrianaivoi* is endemic to dry forests in the far north of Madagascar (Fig. 2). This species is known to occur from sea level to an elevation of ca. 120 m.

IUCN Red List category. With an extent of occurrence (EOO) of 443 km², an area of occupancy (AOO) of 108 km², and four subpopulations (calculation following Callmander et al., 2007), none of which are situated within a protected area, *Stereospermum randrianaivoi* is assigned a preliminary status of Endangered (EN B1ab(iii)+2ab(iii)), according to IUCN criteria (IUCN, 2001).

Phenology. *Stereospermum randrianaivoi* has been recorded in flower and fruit from October to June.

Etymology. The species is named in honor of Richard Randrianaivo, who collected this new species. Richard Randrianaivo (1959–) has conducted botanical inventories in many parts of Madagascar and has made an especially important contribution to the understanding of the plant diversity and endemism in the northern dry forests. He was the leader of bio-prospection for natural products for the International Cooperative Biodiversity Groups (ICBG) project undertaken by the Missouri Botanical Garden (MO) and the Centre National d'Application des Recherches Pharmaceutiques (CNARP).

Observations. *Stereospermum randrianaivoi* can be easily recognized by its coriaceous, usually 3-foliolate leaves (rarely 1- or 5-foliolate), with the tertiary veins of the abaxial surface forming a dense puberulent reticulum, and the adaxial surface of mature leaves usually drying with a pinkish green hue. Perrier de la Bâthie (1938a, 1938b) cited some of the collections we include in the new species under *S. boivinii*. We restrict the latter to its type (*Boivin s.n.*, P) and *Decary 54* (P), both collected near Antsiranana, and *Bardot-Vaucoulon 324* (P) and *Service Forestier 18970* (P) from Ankarana. *Stereospermum boivinii* is distinguished from *S. randrianaivoi* by its shorter, villous calyx (ca. 16 vs. 18–22 mm), the much shorter corolla tube (ca. 18 mm), and the villous indument of the inflorescence axes and pedicels. Another widespread species that extends into the northern dry forests of Madagascar, *S. undatum* can also be confused with *S. randrianaivoi* but differs most noticeably by its glabrescent leaves with more numerous (usually seven or nine) leaflets. In the Loky-Manambato region, several collections, e.g., *Nusbaumer 1945* (G) and *Perrier de la Bâthie 10345* (P), are intermediate between the two species and we suspect that hybridization occurs in this area that is their geographical interface.

Paratypes. MADAGASCAR. s. loc., s.d. (fr.), *R. Baron 6198* (K, P). **Antsiranana:** Commune de Ramena, baie des dunes, 13°14′30″S, 49°22′31″E, 13 May 2004 (fr.), *M. Andrianjafy, J. Razafitsalama, S. Rakotonandrasana, R. Rakotondrajaona, H. Tombondray, R. Guittou, J. Be & V. Benjara 424* (CNARP, MO, P, TAN); Ankarongana, Analafandro, 12°37′50″S, 49°31′28″E, 23 Feb. 2006 (fl. & fr.), *M. Andrianjafy, C. Birkinshaw & Rafaralahy 1625* (CNARP, G, K, MO, P, TAN); Analabolona, 3 km W Irodo, 12°37′21″S, 49°30′01″E, 20 June 2004 (fl.), *J. Be, R. Guittou, J. Razafitsalama & Raymond 10* (CNARP, MO, P, TAN); Montagne des Français, parcelled de York, 12°19′S, 49°20′E, 15 m, 7 Feb. 2003 (fl. & fr.), *M. Bardot-Vaucoulon 1392* (MO, P, TAN); Baie de Rigny, Oct. 1848 (fr.), *L. H. Boivin 2926* (P); Distr. Diégo-Suarez, Orangéa, [12°14′26″S, 49°21′53″E], 22 Jan. 1960 (fr.), *G. Cours & H. Humbert 5411* (MO, P); ca. 6 km from Diégo-Suarez on Diégo-Vovo village rd., 12°19′05″S, 049°23′07″E, 21 Apr. 1993 (fr.), *D. K. Harder, M. C. Merello, S. G. Razafimandimbison & T. G. Razafindrabaeza 1663* (MO, P); PK 10 km 500, route de Diégo-Orangéa, [12°16′09″S, 49°20′45″E], 15 Nov. 1970 (fl.), *M. Keraudren & G. Aymonin 25461* (P [2]); Orangéa, environs de Diégo-Suarez, [12°14′S, 49°22′E], 25 Nov. 1970 (fl.), *M. Keraudren & G. Aymonin 25531* (P); Orangéa, près de Diégo, [12°14′39″S, 49°21′41″E], Jan. 1926 (fl. & fr.), *H. Perrier de la Bâthie 17521* (P [2]); Andrafiabe, Ambolobozobe, Andasimavo, à 5 km 'O du village d'Ampanohana, 12°31′00″S, 49°32′00″E, 28 Mar. 2007, *S. Rakotonandrasana, A. Rakotondrafara & Ali 1131* (CNARP, G, MO, P, TAN); Village de Ramena, Orangéa, 12°15′07″S, 49°22′08″E, 20 m, 24 Feb. 1999 (fl.), *F. Randriatafika & F. Ratovoson 19* (MO, P, TAN); Sadjoavato, forêt de Sahafary, 12°36′26″S, 49°26′43″E, 8 Jan. 2007 (fl.), *F. Ratovoson, L. Razanakolona & V. Benjara 1222* (CNARP, MO, P, TAN); Forêt d'Orangéa, 12°14′08″S, 49°22′08″E, 19 Nov. 2001 (fl. & fr.), *R. Randrianaivo, M. Rabarimanarivo, H. Razafindrabe, J. Andriantiana, A. Ratodimanana, T. G. Razafindrabeaza & Oliver 783* (MO, P, TAN); Irodo, forêt sur sable d'Analafan-

dro, 12°37′14″S, 49°30′03″E, 24 Feb. 2001 (fl. & fr.), *J. Razafitsalama & R. Ludovic 21* (G, MO, P, TAN, TEF, WIS); rd. from Diégo-Suarez to Ramena, along path to Andavakoera, 12°18′57″S, 49°21′39″E, 6 Nov. 2006 (fr.), *Z. Rogers, R. Ranaivojaona, C. Davidson, S. R. Christoph & F. Ratovoson 1113* (G, MO, P, TAN); Forêt d'Andranotsimaka, Diégo, 4 Oct. 1952 (fl. & fr.), *Service Forestier 5786* (MO, P [2], TEF).

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Bauhinia tuichiensis (Fabaceae, Cercideae), una Especie Nueva del Bosque Seco de la Región Madidi, Bolivia

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RESUMEN. *Bauhinia tuichiensis* Cayola & A. Fuentes es una especie nueva de Fabaceae coleccionada en bosque seco durante las expediciones de campo del Proyecto Inventario Florístico de la Región Madidi en Bolivia. Además de *B. cookii* Rose, *B. tuichiensis* es la segunda de 15 especies dentro de la serie *Decandrae* Wunderlin, K. Larsen & S. S. Larsen (tribu Cercideae Bronn, sección *Amaria* (S. Mutis ex Caldas) Endl.) que presenta flores amarillas. *Bauhinia tuichiensis* se diferencia de *B. cookii*, la especie morfológicamente más emparentada, por tener inflorescencias densas (vs. laxas), con raquis corto de ca. 3 mm (vs. 10–15 mm); gineceo más grande 7–10 × 1.5 mm (vs. 4–5 × ca. 0.2 mm), ovario ovoide (vs. linear) y estigma capitado (vs. linear) más ancho 1.5–2 mm (vs. ca. 0.2 mm).

ABSTRACT. *Bauhinia tuichiensis* Cayola & A. Fuentes is a new species of Fabaceae that was collected in dry forest during fieldwork for the Madidi Project in Bolivia. In addition to *B. cookii* Rose, *B. tuichienis* is the second species of 15 within the series *Decandrae* Wunderlin, K. Larsen & S. S. Larsen (tribu Cercideae Bronn, sección *Amaria* (S. Mutis ex Caldas) Endl.) that has yellow flowers. *Bauhinia tuichiensis* differs from *B. cookii*, a morphologically more closely related species, having dense inflorescences (vs. lax) with short rachis ca. 3 mm (vs. 10–15 mm), larger gynoecium 7–10 × 1.5 mm (vs. 4–5 × ca. 0.2 mm), ovoid ovary (vs. linear), and stigma capitate (vs. linear), wider at 1.5–2 mm (vs. ca. 0.2 mm).

Key words: *Bauhinia*, Bolivia, bosque seco, Cercideae, Fabaceae, Lista Roja UICN, Madidi.

El bosque seco andino del Parque Nacional y Área Natural de Manejo Integrado Madidi (Bolivia) es probablemente la formación vegetal más grande e intacta de este tipo en el Neotrópico (Kessler & Helme, 1999), cubre un área aproximada de 1418 km², de los cuales alrededor de 700 km² dentro el Parque Nacional Madidi se encuentra en buen estado de conservación. Sin embargo el sector del bosque seco que se encuentra dentro el Área Natural de Manejo Integrado Madidi sufre problemas de desmonte, quema y pisoteo por ganado vacuno. En 2005 las actividades del Proyecto Inventario Florístico de la Región Madidi se concentraron en esta interesante formación vegetal, encontrando numerosas especies endémicas, así como otras especies nuevas para la ciencia que han sido descritas recientemente, como: *Passiflora madidiana* P. Jørg., Cayola & Araujo-Murakami (Jørgensen et al., 2010) y *Weberbauerocereus madidiensis* Quispe & A. Fuentes (Quispe & Fuentes, 2010). El trabajo de campo realizado tanto en época de lluvia como en época seca permitió coleccionar material fértil para la descripción de la presente especie nueva de *Bauhinia*.

Bauhinia tuichiensis Cayola & A. Fuentes, sp. nov. TIPO: Bolivia. Dpto. La Paz: Prov. Franz Tamayo: Parque Nacional Madidi, Azariamas, Buena Hora, 14°12′22″S 68°39′43″W, 960 m, 30 Sep. 2005 (bot./fl.), *V. Torrez, M. Macia, D. Choque, P. Garagorri, P. Sevillano & J. Mamani 52* (holotipo, LPB; isotipos, BOLV, MA, MO, US, USZ). Figura 1.

Haec species *Bauhiniae cookii* Rose affinis, sed ab ea inflorescentia densa rhachide breviore (ca. 3 mm vs. 10–15 mm longa), gynoecio majore (7–10 × ca. 1.5 mm vs. ca. 4–5 × ca. 0.2 mm), ovario ovoideo (vs. lineari) atque stigmate capitato (vs. lineari) latiore (1.5–2 mm vs. ca. 0.2 mm lato) differt.

Árboles 3.5–10 m, inermes; corteza del tronco con lenticelas conspicuas que forman líneas longitudinales; ramas jóvenes estriadas longitudinalmente, pardo-grisáceas, tomentosas. Estípulas triangulares, ca. 1.5 × 1 mm, ápice membranoso, base coriácea, glabras adaxialmente, tomentosas abaxialmente, caducas; hojas bilobadas 2/3 de su longitud, lámina (5.2–)6.9–7.8(–9.3) × 6.5–8(–10) cm, papiráceas, haz glabro, envés tomentuloso, base cordada, ápice de los lóbulos agudo, 9-nervada, nervadura impresa en el haz, prominente en el envés, nervios marginales apenas conspicuos, nervios principales densamente tomentosos en el primer tercio basal; mucrón (1–)

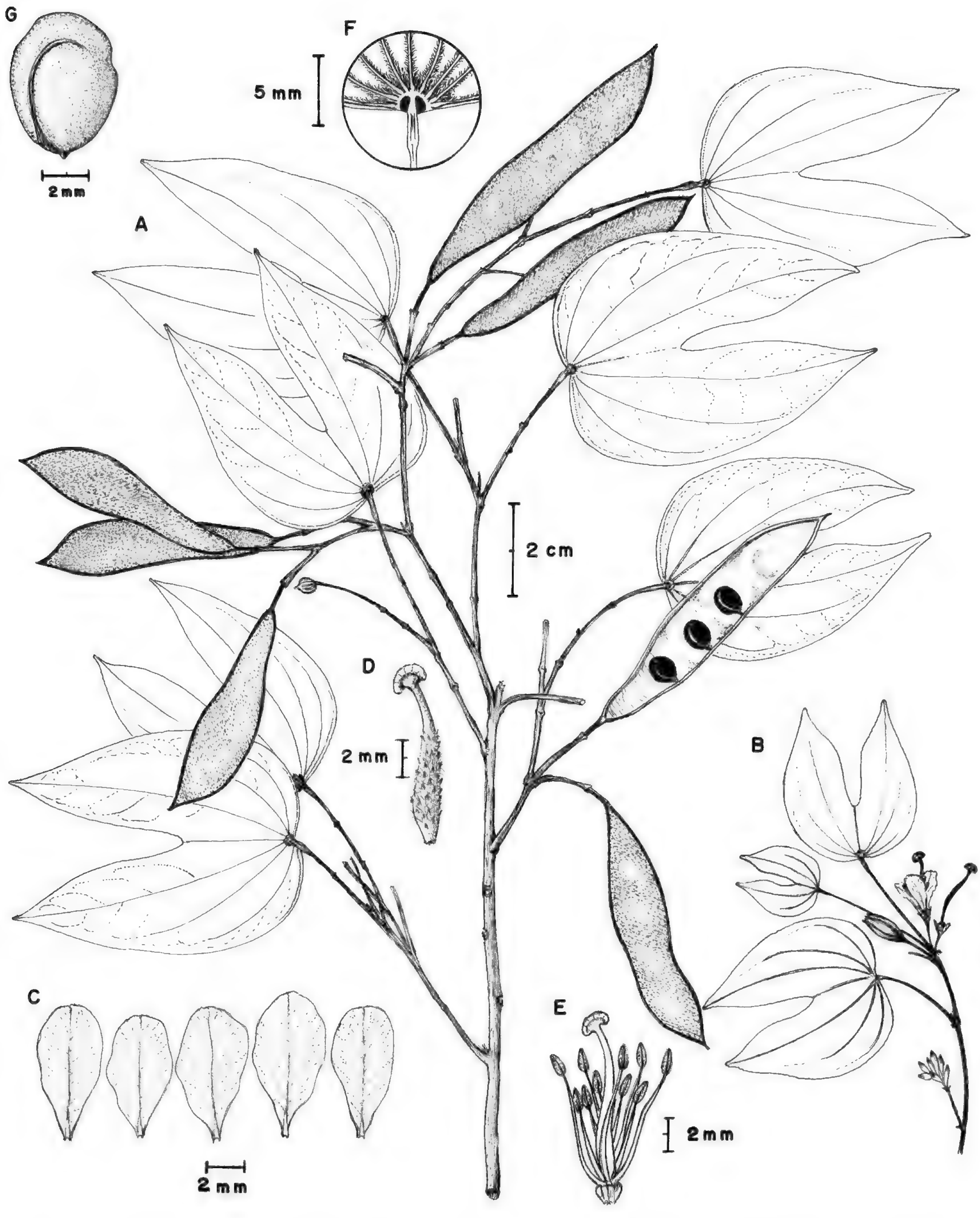

Figura 1. *Bauhinia tuichiensis* Cayola & A. Fuentes. —A. Rama con frutos. —B. Rama con botones y flores. —C. Pétalos. —D. Detalle del gineceo. —E. Gineceo y estambres. —F. Detalle de la pubescencia en el envés de las hojas. —G. Semilla. Ilustrado por Carlos Maldonado. A y F basado en el paratipo *N. Paniagua et al. 5619* (LPB); B–E basado en el tipo *V. Torrez et al. 52* (LPB); G basado en el paratipo *J. Uzquiano et al. 206* (LPB).

1.5(–2) mm; pecíolo (2.8–)3–3.6(–4.3) cm, canaliculado, con un pulvínulo basal y otro apical, tomentuloso en hojas tiernas. Inflorescencias racimos terminales y axilares densos con 6 ó 7 flores; raquis 3 mm de largo, botones florales verdes en la base, marrones hacia el ápice, (8–)10 × 2(–3.5) mm, obovados, densamente tomentosos, pelos del ápice morados; bráctea 0.8–1.1 × ca. 1 mm, ferrugínea a marrón oscuro, tomentosa; pedicelo (5–)8–10 mm, densamente tomentoso. Flores hermafroditas, pen-

támeras; cáliz espátaceo (3–)4(–5) mm, glabro adaxialmente, tomentoso ferrugíneo abaxialmente; pétalos obovados 5, 7–8 × 4–5 mm, amarillos, glabros; estambres 10, connados en la base, 5 largos (ca. 3 mm) y 5 cortos (1.5–1.8 mm), anteras ca. 0.8 × 0.2 mm; hipanto aprox. 0.8–1 × ca. 2 mm; gineceo 8–10 × ca. 1.5 mm, estriguloso, tomentoso, ovario ovoide constreñido hacia el estigma; estigma capitado 1.5–2 mm de ancho, margen ondulado. Fruto legumbre dehiscente, 4.4–6.2 × 1–1.2 cm, inmaduro verde, maduro marrón; semillas ovadas a rómbicas, 1 a 5 por fruto, 6–8 × 4.8–6 mm, de color marrón, hilo apical.

Etimología. El bosque seco de la Región Madidi esta surcado por tres afluentes principales, los ríos Tuichi, Machariapo y Resina. Siendo el principal afluente el río Tuichi, al cual desembocan además de los ya mencionados, otros secundarios como los ríos Ubito y San Juan. *Bauhinia tuichiensis* hace alusión al río Tuichi.

Distribución y hábitat. Esta especie fue coleccionada por primera vez cerca a la confluencia del río Tuichi con el río Machariapo, sin embargo es más frecuente cerca a la confluencia del río Tuichi con el río Resina y en los alrededores de la comunidad de Azariamas. *Bauhinia tuichiensis* es una especie restringida a la cuenca media del río Tuichi, desde su intersección con el río Machariapo hasta el río San Juan. Se desarrolla con preferencia en las laderas y terrazas más xéricas del bosque seco andino entre 700 y 1000 m de altitud. Se cuenta con colecciones de cinco localidades y se distribuye de manera constante en toda la formación vegetal.

Categoría de la Lista Roja de UICN. La consideramos como una especie Vulnerable (VU B2ac) debido a que su área de ocupación estimada es menor a 2000 km^2 (UICN, 2001). La parte de bosque seco ubicado dentro el Parque Nacional Madidi está bien conservada, sin embargo su área de distribución en el Área Natural de Manejo Integrado Madidi se encuentra fragmentada por la colonización, pastoreo, quemas, deforestación y construcción de caminos.

Fenología. La especie ha sido colectada con botones y flores en septiembre, con frutos inmaduros en febrero, y con frutos maduros y viejos entre mayo y junio. Al parecer florece y fructifica de manera sincronizada con la época seca, la cual dura de marzo a abril hasta septiembre a octubre. Debido a que *Bauhinia tuichiensis* es una especie caducifolia, los especímenes encontrados con botones y flores, solo contaban con brotes y hojas tiernas. Al contrario de los especímenes con frutos que contaban con hojas adultas.

Diagnóstico de los caracteres y posibles relaciones. Por ser un árbol y poseer un androceo de 10 estambres, *Bauhinia tuichiensis* corresponde a la tribu Cercideae Bronn, *Bauhinia* sección *Amaria* (S. Mutis ex Caldas) Endl., serie *Decandrae* Wunderlin, K. Larsen & S. S. Larsen (Wunderlin, 2006). La sección *Amaria* comprende 16 especies distribuidas desde el oeste de México hasta Brasil. La serie *Decandrae* agrupa a 15 de las 16 especies de la sección *Amaria* (Wunderlin, 2006). Las especies de esta serie presentan flores rojas, rosadas, blancas y amarillas. *Bauhinia cookii* y *B. tuichiensis* son las únicas especies de esta serie que poseen flores amarillas. Las diferencias entre *B. cookii* y *B. tuichiensis* se presentan esencialmente en la inflorescencia y el gineceo. Las inflorescencias de *B. tuichiensis* son densas y presentan un raquis corto (ca. 3 mm). El largo total del gineceo es de 7 mm en botones maduros y 10 mm en flores después de la antesis. El gineceo es de ca. 1.5 mm de ancho, ovario ovoide constreñido hacia el estigma. El estigma es capitado, 1.5–2 mm de ancho y de borde ondulado. *Bauhinia cookii* posee inflorescencias laxas con un raquis largo (10–15 mm). El largo del gineceo es de 4–5 mm y su ancho de ca. 0.2 mm, el ovario y estigma son lineares. El estigma tiene un ancho de ca. 0.2 mm.

Se diferencia de *Bauhinia haughtii* Wunderlin y *B. weberbaueri* Harms porque ambas especies presentan ovario glabro, mientras que *B. tuichiensis* tiene un ovario estrigoso y tomentoso. Adicionalmente las flores de *B. haughtii* son rojas y las de *B. weberbaueri* son rosadas o rojizas, mientras que las de *B. tuichiensis* son amarillas.

Paratipos. BOLIVIA. **Dpto. La Paz:** Franz Tamayo, Parque Nac. Madidi, NW de Apolo, Azariamas, río Resina, 8 jun. 2005 (fr.), *L. Cayola 1745* (LPB, MO); Parque Nac. Madidi, camino Apolo-Azariamas, arroyo Pintata, 3 mar. 2003, *L. Cayola, A. Araujo, M. Calzadilla, C. Maldonado, R. Alvarez & A. Alvarez 254* (LPB, MO); Parque Nac. Madidi, camino Apolo-Azariamas, arroyo Pintata, 19 feb. 2003, *L. Cayola, A. Araujo, H. Cabrera, M. Calzadilla, F. Canqui, C. Maldonado & N. Paniagua 14* (LPB, MO); 25 feb. 2003, *L. Cayola, A. Araujo, M. Calzadilla, C. Maldonado, R. Alvarez & A. Alvarez 160* (LPB, MO); 26 feb. 2003 (fr.), *N. Paniagua, H. Cabrera, F. Canqui, M. Álvarez & A. Álvarez 5619* (LPB, MO); Parque Nac. y Área Nat. de Manejo Integrado Madidi, Azariamas, N de Apolo, 25 may. 2005 (fr.), *A. Fernández, L. Cayola, J. Uzquiano, P. Sevillanos & G. Jove 80* (LPB, MO); 13 jun. 2005 (fr.), *C. Campos, A. Araujo, A. Antezana, D. Choque, V. Torrez, R. Jove & G. Jove 114* (LPB, MO); Azariamas, 7 jun. 2005 (fr.), *J. Uzquiano, L. Cayola, A. Fernández, G. Jove & P. Sevillanos 206* (LPB, MO); Área Natural de Manejo Integrado Madidi, encuentro Azariamas, 1 oct. 2005, *L. Cayola, C. Campos, A. Poma, R. Jove & H. Ubano 1796*

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Nomenclatural Notes on *Eriotheca* (Bombacoideae, Malvaceae)

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Abstract. As part of the taxonomic treatment of *Eriotheca* Schott & Endl. in Brazil (Bombacoideae, Malvaceae), a lectotype is designated for *Bombax crenulatum* K. Schum. [= *E. gracilipes* (K. Schum.) A. Robyns], and an epitype is selected for *E. globosa* (Aubl.) A. Robyns. The change of status is proposed for two names in *Eriotheca*. *Eriotheca candolleana* (K. Schum.) A. Robyns var. *longipes* A. Robyns is recognized at the species level as *E. longipes* (A. Robyns) M. C. Duarte & G. L. Esteves; *E. macrophylla* (K. Schum.) A. Robyns subsp. *sclerophylla* (Ducke) A. Robyns is also recognized at species rank as *E. sclerophylla* (Ducke) M. C. Duarte & G. L. Esteves.

Resumo. Durante o estudo taxonômico de *Eriotheca* Schott ex Endl. no Brasil (Bombacoideae, Malvaceae), verificou-se que mudanças eram necessárias. São designados um lectótipo para *Bombax crenulatum* K. Schum. [= *E. gracilipes* (K. Schum.) A. Robyns] e um epítipo para *E. globosa* (Aubl.) A. Robyns. Duas mudanças de status são propostas: *E. candolleana* (K. Schum.) A. Robyns var. *longipes* A. Robyns para *E. longipes* (A. Robyns) M. C. Duarte & G. L. Esteves e *E. macrophylla* (K. Schum.) A. Robyns subsp. *sclerophylla* (Ducke) A. Robyns para *E. sclerophylla* (Ducke) M. C. Duarte & G. L. Esteves.

Key words: Bombacoideae, Brazil, *Eriotheca*, Malvaceae.

Eriotheca Schott & Endl. (Bombacoideae, Malvaceae s.l.) comprises about 24 species distributed in South America. In Brazil, the genus is represented by 16 species, from northern Brazil to the state of São Paulo, which represents its southern extent. The genus is known to occur in the Atlantic rainforest, as well as Amazon forest and cerrado. *Eriotheca* is characterized by its small flowers that reach to 6.5 cm long and by the 18 to 170 stamens partially connate, with the free filaments that emerge from the apex of the staminal tube (Robyns, 1963; Duarte, 2010).

Eriotheca has been historically interpreted differently in the taxonomic literature. The genus was established by Schott and Endlicher in 1832 on the basis of two species originally described within *Bombax* L. Schumann (1886) and van den Brink (1924) would later reject the use of *Eriotheca*, either synonymizing it under *Bombax* or recognizing it within *Bombax* sect. γ *Eriotheca* (Schott & Endl.) Bakh. It was not until 1963 that André Robyns would recognize *Eriotheca* at the rank of independent genus again, and his revision of *Bombax* s.l. is the most significant recent study of these taxa. The current authors recognize 19 species in *Eriotheca*, divided in four subgenera, three of which have Brazilian representatives, as *Eriotheca* subg. *Eriotheca* Schott & Endl., *Eriotheca* subg. *Tartagalia* (Capurro) A. Robyns, and *Eriotheca* subg. *Macrosiphon* A. Robyns (Duarte, 2010). During the preparation of a taxonomic revision of *Eriotheca* in Brazil, nomenclature within *Eriotheca* was clarified to facilitate future taxonomic treatments, as follows.

Eriotheca Schott & Endl., Melet. Bot. 35. 1832. TYPE: *Eriotheca pubescens* (Mart. & Zucc.) Schott & Endl. (lectotype, designated by Robyns [1963: 125]).

Discussion. The history of the species type of the genus *Eriotheca* began in 1825, when Martius and Zuccarini described *Bombax parvifolium* Mart. & Zucc. (Martius, 1825). In 1826, the same authors committed an orthographic error, writing *B. parviflorum* instead of *B. parvifolium* (Martius, 1826). In 1832, Schott and Endlicher described the genus *Eriotheca*, characterized by the stamens partially connate, with free filaments emerging from the apex of the staminal tube, differing from *Bombax*, whose stamens emerge from the apex of the staminal tube

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united in two androecial whorls. In the same study, the authors did not explicitly designate a type for the genus and proposed two new combinations based on the names published in 1826, transferring *B. pubescens* Mart. & Zucc. as *E. pubescens* (Mart. & Zucc.) Schott & Endl., and *B. parviflorum* Mart. & Zucc. became *E. parviflora* (Mart. & Zucc.) Schott & Endl. In 1963, André Robyns in his revision of *Bombax* s.l., realized the orthographic error and proposed a new combination based on the name published in 1825: *B. parvifolium* Mart. & Zucc. became *E. parvifolia* (Mart. & Zucc.) A. Robyns. Aside from this, Robyns would effectively designate a lectotype for the genus *Eriotheca*, based on the earlier combination, published in 1832, as *E. pubescens* (Mart. & Zucc.) Schott & Endl.

1. Eriotheca gracilipes (K. Schum.) A. Robyns, Bull. Jard. Bot. État Bruxelles 33(1): 145. 1963. Basionym: *Bombax gracilipes* K. Schum., Fl. Bras. (Martius) 12(3): 221, tab. XLII. 1886. TYPE: Brazil. Mato Grosso, s.d., *H. A. Weddell 3336* (lectotype, designated by Robyns [1963: 145], P not seen).

Bombax crenulatum K. Schum., Fl. Bras. (Martius) 12(3): 219. 1886. TYPE: Brazil. São Paulo, s.d., *W. J. Burchell 5252* (lectotype, designated here, K-000601265, digital image seen).

Discussion. Robyns (1963) did not designate a lectotype for *Bombax crenulatum*, but did annotate the Kew collection as a syntype (Robyns, in sched.). Schumann (1886) cited six syntypes in the protologue. With the exception of the collection *Sellow 1448*, probably destroyed in Berlin, all the remaining collections (*Burchell 5252*, K, *Riedel 2282*, K; *Regnell I275*, R; *Lund s.n.*, C; *Riedel 448*, LE) were analyzed. The collection *Burchell 5252* (K) was chosen as lectotype because it corresponds to the description in the protologue (three to five leaflets and calyx campanulate to cupuliform, with toothed margin).

2. Eriotheca globosa (Aubl.) A. Robyns, Bull. Jard. Bot. État Bruxelles 33(1): 142. 1963. Basionym: *Bombax globosum* Aubl., Hist. Pl. Guiane 2: 701, tab. 281. 1775. TYPE: French Guiana. "Habitat Caiennae propè Loyola," tab. 281, in Aublet, 1775: 701 (lectotype, designated by Robyns [1963: 142], as "holotype," tab. 281 in Aublet, 1775). EPITYPE: Brazil. Amazonas: Rio Cauaburí, base da cachoeira Caranguejo, 4 Nov. 1965, *B. Maguire, J. A. Steyermark & C. K. Maguire 60097* (epitype, designated here, MG; duplicates, MO-1827703, NY).

Discussion. The collection *Maguire et al. 60097* (MG, MO, NY) is chosen as an interpretative epitype, according to the Vienna Code (Art. 9.7; McNeill et al., 2006), because the specimen presents the principal morphological characters to recognize *Eriotheca globosa*, which include the floccose-ferrugineous calyx, the reddish petiolules and leaflets, and the flowers reaching only 2.5 cm in length, the smallest *Eriotheca* of the Amazon. Aublet's plate 281 (1775: 701) is not sufficient to recognize the species because it lacks these characters as cited above. Aside from this, the plate shows characters compatible with other species of *Eriotheca* such as the globose fruits and leaves with five leaflets. Even though the *Maguire et al. 60097* collection is from Amazonas in Brazil, it is representative of the taxon as first described from French Guiana.

3. Eriotheca longipes (A. Robyns) M. C. Duarte & G. L. Esteves, comb. et stat. nov. Basionym: *Eriotheca candolleana* (K. Schum.) A. Robyns var. *longipes* A. Robyns, Bull. Jard. Bot. État Bruxelles 33(1): 136. 1963. TYPE: Brazil. Rio de Janeiro: Rio de Janeiro, Jardim Botânico (cult.), s.d., *A. Duarte s.n.* (holotype, RB-78222).

Discussion. The characters utilized by Robyns (1963) to describe *Eriotheca candolleana* var. *longipes* do not fit the delimitation of *E. candolleana*. The latter taxon was distinguished by its number of leaflets, number of nectaries on the receptacle, color of nerves, as well as pedicel lengths. However, both taxa are distinctive and the differences are sufficient to consider the variety as a species. The leaflets number three to five in *E. longipes* (vs. five to nine in *E. candolleana*), the nectaries are one to three (vs. five to seven), blade nerves are brown (vs. ferrugineous), and pedicels are longer, 2.5–7 cm (vs. 0.2–4 cm). *Eriotheca longipes* may also be recognized by the lower number of stamens (70 to 80) and the denser inflorescence, with five to 12 flowers per cyme. This differs from *E. candolleana*, which presents 100 to 120 stamens and one to five flowers per cyme.

The two species may be distinguished by their distribution. *Eriotheca longipes* is known to occur only in the states of Minas Gerais and Bahia in Brazil, while *E. candolleana* is broadly distributed across the states of central Brazil (Goiás, Mato Grosso, Mato Grosso do Sul, and Distrito Federal), the southern region (Minas Gerais, São Paulo, and Espiríto Santo), and also in the municipality of Alcobaça in Bahia.

Representative specimens examined. BRAZIL. **Bahia:** Vitória da Conquista, rod. Conquista/Barra do Choça, *T. S.*

Santos 2554 (CEPEC, R). **Minas Gerais:** Juiz de Fora, Sítio da Divina Providência, *L. Krieger s.n.* (CESJ-15275); Marliéria, Parque Est. do Rio Doce, 21 Oct. 1991, *J. R. Stehmann s.n.* (UEC-124962), *W. P. Lopes 159 & V. V. Scudeller 616* (SP, VIC); Patos de Minas, Serra da Mata de Corda, *A. P. Duarte 4237* (RB-88751); Lima Duarte, São José dos Lopes, *V. C. Almeida 59* (R).

4. Eriotheca sclerophylla (Ducke) M. C. Duarte & G. L. Esteves, comb. et stat. nov. Basionym: *Bombax sclerophyllum* Ducke, Arq. Inst. Biol. Veg. 2: 58. 1935. *Eriotheca macrophylla* (K. Schum.) A. Robyns subsp. *sclerophylla* (Ducke) A. Robyns, Bull. Jard. Bot. État Bruxelles 33(2): 154. 1963. TYPE: Brazil. Amazonas: Santa Izabel do Rio Negro, 7 Jan. 1932, *A. Ducke s.n.* (holotype, RB-24825).

Discussion. Originally described as a species within *Bombax* by Ducke (1935), the taxon was transferred by Robyns (1963) to *Eriotheca macrophylla* on the basis of the small flowers and the staminal tube without whorls. In agreement with Ducke's earlier opinion that the taxon is distinctive at the species level, this rank is recognized within the different generic placement. *Eriotheca sclerophylla* can be distinguished by the leaflets that are completely glabrous and extremely rigid and leathery. It differs from *E. macrophylla* by the greater height of the trees, to 40 m (vs. 25 m in *E. macrophylla*), and the shape of the ovary, which is conical (vs. globose).

Both taxa may also be distinguished by their different geographic distribution in Brazil. *Eriotheca macrophylla* is known from the Atlantic rainforest (restricted to the states of Pernambuco, Alagoas, Bahia, Minas Gerais, Espírito Santo, and Rio de Janeiro), whereas *E. sclerophylla* occurs more broadly in Amazonian wet forests (Colombia, Peru, and Brazil, in the state of Amazonas). For *E. sclerophylla* and other species of *Eriotheca* that occur in the Amazon forest (*E. globosa* and *E. surinamensis* (Uittien) A. Robyns), these trees present leaves with three to five leaflets and may reach 40 m in height. However, these taxa differ by the characters of the calyx shape and margin, by the indumentum, and by the pedicel lengths.

Representative specimens examined. BOLIVIA. **La Paz:** Prov. Sud Yungas, basin of Rio Bopi, San Bartolomeo, *B. A. Krukoff 10326* (F, MO, NY, US). BRAZIL. **Alagoas:** Rio Largo, *R. P. Lyra-Lemos & L. Noblick 2639* (MAC). **Amazonas:** Santa Izabel do Rio Negro, Rio Negro, 7 Jan. 1932, *A. Ducke s.n.* (RB-24825). **Bahia:** Guaratinga, *R. P. Belém & R. S. Pinheiro 2745* (CEPEC, US). **Espírito Santo:** Linhares, Reserva Flor. Vale do Rio Doce, *J. Spada 25/77* (CVRD, R, WIS). **Minas Gerais:** Coronel Pacheco, *Heringer 2412* (RB). **Pernambuco:** Brejo da Madre de Deus, 8°12′27″–8°12′41.5″S, 36°23′7.30″–6°23′3.20″W, *L. M. Nascimento et al. 195* (HUEFS, RB). **Rio de Janeiro:** Rio das Ostras, Reserva Biol. União, *P. P. Oliveira 194M* (BHCB, UEC). COLOMBIA. **Vaupés:** Rio Kananarí, Cerro Isibukuri, *R. E. Schultes & I. Cabrera 14700* (F, US). PERU. **Madre de Dios:** Cashucocha, Manu National Park, *A. Gentry et al. 26950* (MO).

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A New Species of *Pelexia* (Orchidaceae, Spiranthinae) from São Paulo, Brazil

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Abstract. A new species of *Pelexia* Poit. ex Lindl. (Orchidaceae, Spiranthinae) occurring in central São Paulo, southeastern Brazil, is described and illustrated as *P. vinosa* A. W. C. Ferreira, M. I. S. Lima & Pansarin. *Pelexia vinosa* is recognized by its leaves that are present at flowering and its dark purple leaf blades with reddish margins. Inflorescences are sparsely pubescent and reddish. The red sepals contrast with the white hyaline petals and labellum. The species is notable for its spurlike nectary that is parallel and adnate to the ovary. The new species is morphologically similar to *P. laxa* (Poepp. & Endl.) Lindl. In addition, the need to preserve native areas of the interior of São Paulo State (habitat of *P. vinosa*) is discussed.

Resumo. Uma nova espécie de *Pelexia* Poit. ex Lindl. (Orchidaceae, Spiranthinae) que ocorre na região central do estado de São Paulo, é descrita e ilustrada como *P. vinosa* A. W. C. Ferreira, M. I. S. Lima & Pansarin. *Pelexia vinosa* é reconhecida pelas folhas que estão sempre presentes durante o período de floração, e pelas lâminas foliares roxo-escuras com margens avermelhadas. As inflorescências são avermelhadas e esparsamente pubescentes. As pétalas avermelhadas contrastam com as pétalas e labelo, que são brancos, e pelo nectário paralelamente disposto e adnato ao ovário. Essa nova espécie é morfologicamente semelhante à *P. laxa* (Poepp. & Endl.) Lindl. A necessidade de conservação de áreas nativas no interior do estado de São Paulo (hábitat de *P. vinosa*), também é discutida.

Key words: Atlantic rainforest, cerrado, IUCN Red List, Orchidaceae, *Pelexia*, Spiranthinae.

Within the Orchidaceae, the tribe Cranichideae is cosmopolitan in distribution and comprises ca. 90 genera and 1600 species that are further recognized among six subtribes, one of which is the Spiranthinae (Salazar, 2003). The Spiranthinae encompass 39 genera, of which *Pelexia* Poit. ex Lindl. contains 76 species distributed from Mexico to Argentina (Hoehne, 1945; Pabst & Dungs, 1975; Salazar, 2003). *Pelexia* consists of terrestrial, lithophytic, or more rarely epiphytic herbs (Salazar, 2003). In Brazil, 38 species of *Pelexia* are found (Barros et al., 2012), occurring in several vegetation physiognomies, including ombrophilous (e.g., Miller & Warren, 1996; Romanini & Barros, 2007), semideciduous mesophytic (e.g., Pansarin & Pansarin, 2008, 2010), Amazonian forests (Ribeiro, 1992), as well as cerrado vegetation (e.g., Batista & Bianchetti, 2003). Furthermore, Brazilian species of *Pelexia* can be found in diverse habitats that include marshy areas, rocky outcrops, and both dry and wet grasslands (Cogniaux, 1893–1896; Hoehne, 1945; Pabst & Dungs, 1975; Sprunger et al., 1996). Seven species of *Pelexia* are known to occur in the central region of the state of São Paulo (Ferreira et al., 2010). This is an area consisting of an ecotone between two important Brazilian biomes, namely the cerrado and Atlantic forest (Kronka et al., 1993; Soares et al., 2003). The climate of the region is classified as "Cwa," namely mesothermic with a dry winter season (Köppen, 1948). The new species described herein was discovered while the authors carried out a floristic survey of the Orchidaceae in central São Paulo in southeastern Brazil.

The genus *Pelexia* is characterized by the presence of fleshy and fasciculate roots, and the leaves are

organized in a rosette, but are generally absent during the flowering time. The flowers of *Pelexia* are resupinate and arranged in racemes or spikes. The lateral and dorsal sepals are glandular pubescent, and the lateral sepals are variably connate at the base, generally forming a spur. The labellum is united to the base of the column and the pollinarium is formed by two oblong to clavate pollinia (Ackerman, 1995; Salazar, 2003).

Materials and Methods

Fresh and herbarium material of flowering and fruiting plants were used for the description. Illustrations were based on specimens collected in the field and then grown in a greenhouse at the Botany Department, Federal University of São Carlos, within the municipality of São Carlos (approx. 22°01′S, 47°53′W; 854 m.s.m.) until flowering. Floral features were drawn using a stereomicroscope with an attached camera lucida. Vegetative and floral structures were photographed with a digital camera (Canon EOS Rebel X, Tokyo, Japan) and through a stereomicroscope (Stereozoom Leica S8 APO, Heerbrugg, Switzerland) with an integrated photo output. Terminology for describing leaf shapes follows Radford et al. (1974). Features specific to the Orchidaceae were based on Dressler (1993) and Pridgeon et al. (1999). Original protologues and digital images of holotypes (K, NY, RENZ, S, SP, and W) of related species of *Pelexia* were consulted.

Pelexia vinosa A. W. C. Ferreira, M. I. S. Lima & Pansarin, sp. nov. TYPE: Brazil. São Paulo: Itirapina, Itaqueri da Serra, 22°20′S, 47°52′W, 860 m.s.m., 18 Feb. 2007 (fl.), *A. W. C. Ferreira s.n.* (holotype, UEC 148368). Figures 1, 2.

Pelexia vinosa ab omnibus aliis speciebus sui generis foliis atropurpureis marginibus rubentibus, scapo rubente leviter pubescente, sepalis rubris sparsim pubescentibus, petalis albo-pellucidis, calcari ad ovarium parallelo adnatoque distinguenda; a *Pelexia laxa* (Poepp. & Endl.) Lindl. foliis minoribus immaculatis apice acuto, sepalis lateralibus non decurrentibus, terminali obovato, labello omnino albo lobo apicali transverse ovali, lateralibus falcatis atque ovario recto vel paulo arcuato differt.

Sympodial and terrestrial herbs to 28 cm tall; roots 3–7 × 0.5–0.8 cm, not ramified, cream to whitish in color, sparsely pubescent; stem reduced, with up to 5 leaves. Leaves 4.5–13 × 3–7.3 cm, blade adaxially dark purple, abaxially paler purple, asymmetrically ovate, subcoriaceous, apex acute, margin entire, reddish, the central vein dark purple; pseudopetiole 1.8–2.8 × 0.25–0.35 cm, cylindrical, with a longitudinal keel adaxially. Inflorescence 15–28 × 0.5 cm, racemose, lateral, erect, with 12 to 22 flowers successively opening; scape reddish, pubescent, with 6 to 11 bracts; bracts 1.8–2.5 × 0.4–0.5 cm, lanceolate, adpressed. Flowers resupinate; ovary and pedicel ca. 1–1.3 cm, red-tinged, sparsely pubescent; sepals red with small white dots at the apex, externally pubescent; dorsal sepal 1.2 × 0.6 cm, symmetrically obovate, involving the column, apex acuminate; lateral sepals asymmetrically linear to lanceolate, not decurrent, embracing the labellum, its base adnate to the column foot and the ovary apex forming a spurlike nectary, marginally white from mid-portion to the apex, apex rounded; nectary longitudinally adnate to the ovary; petals 1.2 × 0.3 cm, spatulate, red from median portion to the base, white and hyaline toward the apex, margin entire, apex acute and with small hyaline glandular dots; labellum 1.4 × 0.6 cm, 3-lobed, canaliculate, incurved, white, with 2 basal projections; these projections 5 × 1 mm, oblong, apical lobe transversally oval, lateral lobes triangular, falcate, partially overlapping the apical lobe; column 9 × 1.5 mm, clavate, white, with a white rostellum and a yellow stigmatic surface; anther cap 4 × 2 mm, deltoid; pollinarium composed of 2 clavate, bipartite and white pollinia, and a terminal, ovate and dorsally adhesive viscidium. Fruit 1.3 × 0.7 cm, erect, cylindrical.

Distribution and habitat. *Pelexia vinosa* is only known from the type locality in São Paulo, where it occurs in an ecotone between cerrado vegetation and semideciduous mesophytic forest. *Pelexia vinosa* was found close to a stream in a gallery forest.

IUCN Red List category. Based on the evidence that the surrounding natural habitat has been developed as pasturelands and cultivation, mainly for sugarcane (*Saccharum officinarum* L.), *Pelexia vinosa* is considered a Vulnerable (VU) species, according to IUCN (2001) criteria.

Phenology. *Pelexia vinosa* was observed to flower from January to March, with each flower lasting from 10 to 12 days. The fruits are dehiscent from March to May.

Etymology. The specific epithet of *Pelexia vinosa* refers to the dark purple coloration of the leaf blades.

Taxonomic notes. *Pelexia vinosa* is easily recognized by its dark purple leaves with reddish margins that remain present at flowering, by its sparsely pubescent and reddish inflorescence, and by the reddish sepals that contrast well with the white to

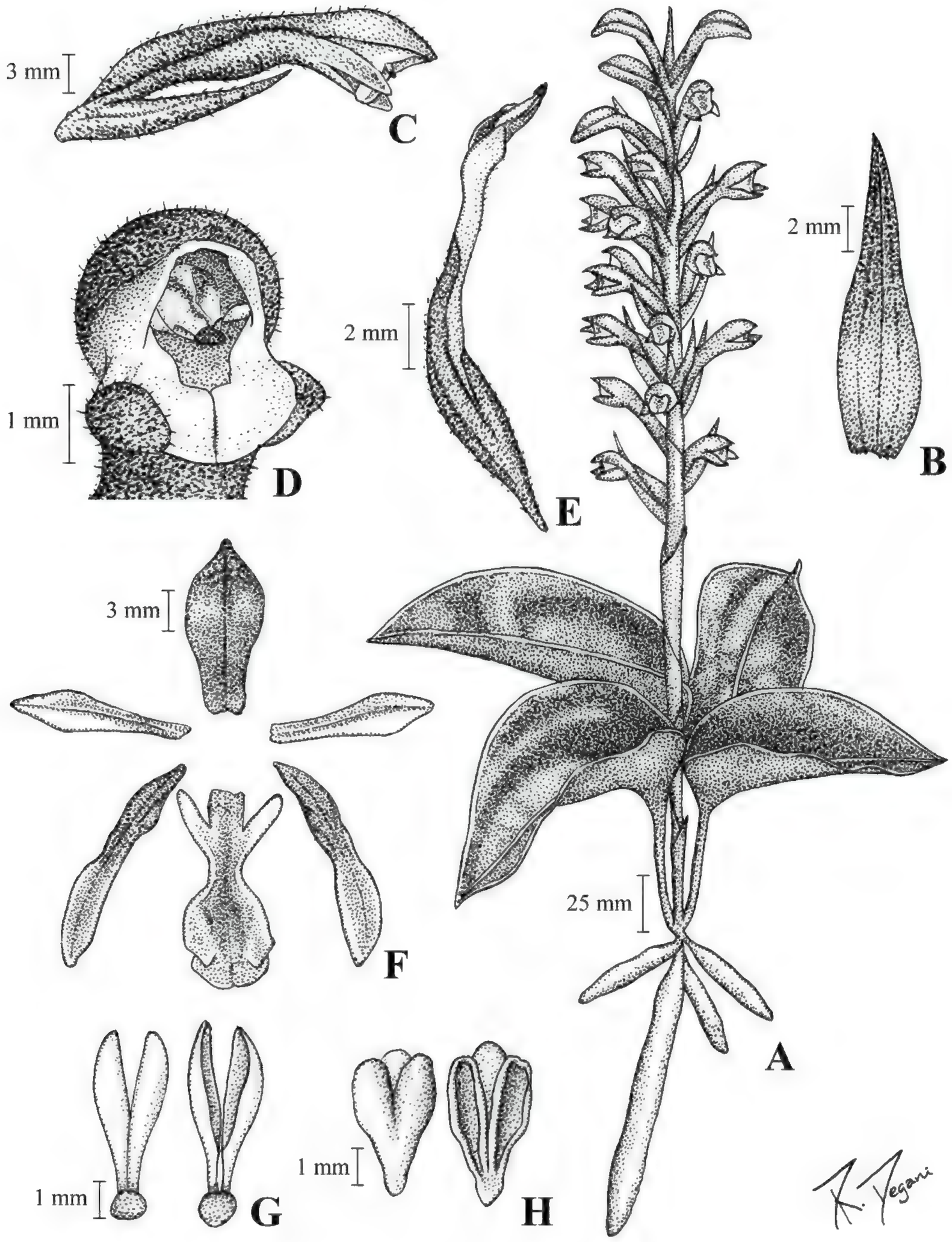

Figure 1. *Pelexia vinosa* A. W. C. Ferreira, M. I. S. Lima & Pansarin. —A. Flowering plant. —B. Bract. —C. Flower, lateral view, with a floral bract visible below. —D. Flower, frontal view. —E. Ovary and column, lateral view. —F. Dissected perianth parts. —G. Pollinarium, adaxial (left) and abaxial (right) views. —H. Anther, adaxial (left) and abaxial (right) views.

hyaline petals and labellum, and with the spur parallel and completely adnate to the ovary. The new species is closely related to *P. laxa*. However, *P. vinosa* differs from *P. laxa* by the absence of maculae on the leaf blades, the more congested inflorescence, the lateral sepals not decurrent, the dorsal sepal spatulate, and the labellum being entirely white with an apical lobe that is transversally oval and triangular and with lateral lobes that are falcate. In *P. laxa*, the leaves are maculate, the inflorescences are more elongate and lax, the lateral sepals are decurrent, the dorsal sepal is elliptic, and the labellum is yellow in the middle with an apical lobe that is cordiform and with lateral lobes that are triangular. Although Barros et al. (2012) reported the occurrence of *P. laxa* from northern Brazil, this species was recorded from the central region of the state of São Paulo, flowering from September to November (Ferreira et al., 2010). Because species of *Pelexia* are cultivated as ornamental orchids (Salazar, 2003), we believe that the new species also has ornamental potential, based on its beautiful dark purple leaf blades and the reddish inflorescences and sepals that markedly contrast with the white petals and labellum.

In Brazil, native areas of the cerrado vegetation, the Atlantic rainforests, and ecotonal areas between both biomes (the natural habitat of *Pelexia vinosa*) have been considered crucial for preservation and conservation as rich in species diversity and endemism. Currently, these Brazilian biomes are

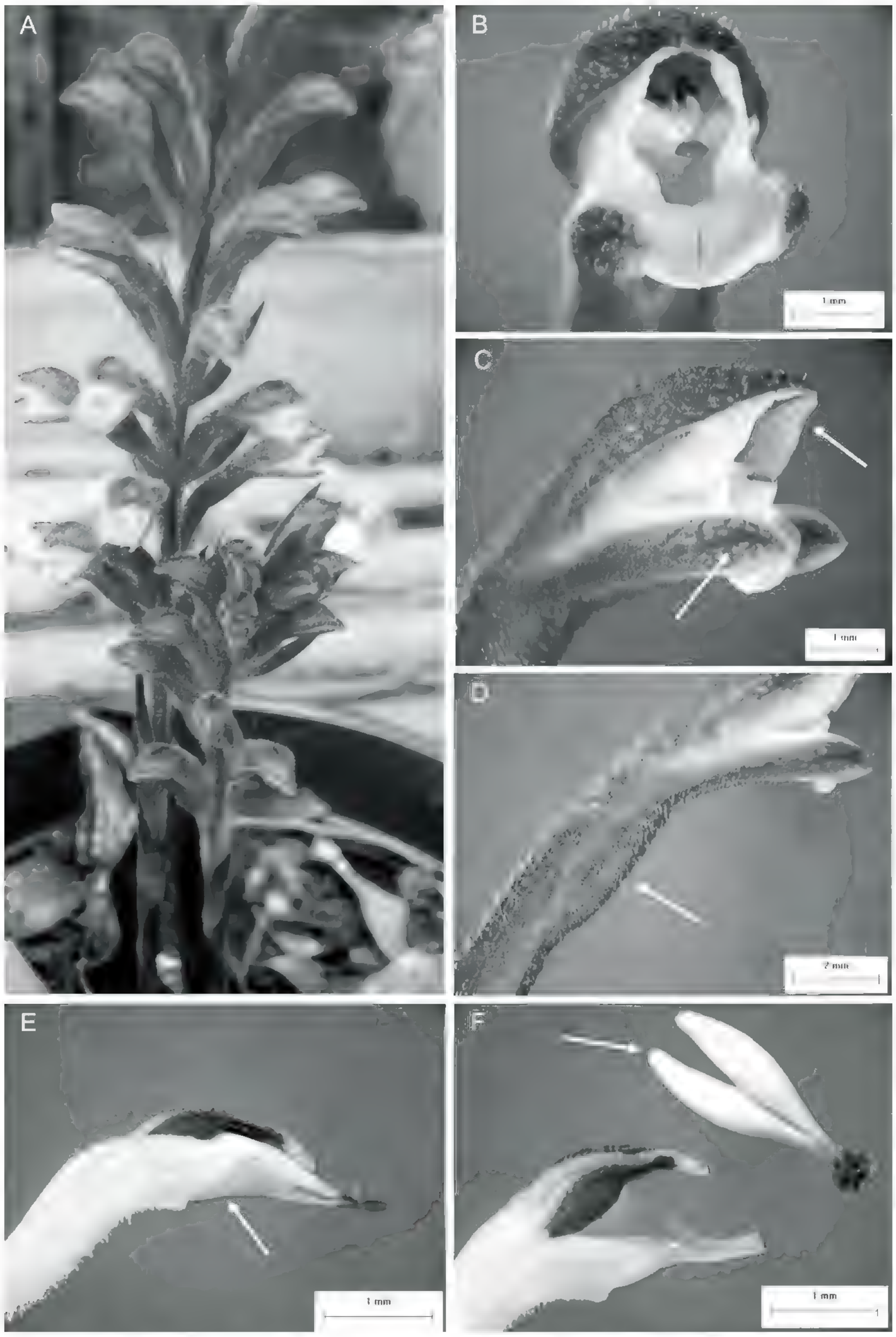

Figure 2. *Pelexia vinosa* A. W. C. Ferreira, M. I. S. Lima & Pansarin. —A. Flowering plant. —B. Flower, frontal view. —C. Flower, lateral view. Note the glandular dots on sepal and petal apices (arrows). —D. Detail of flower, lateral view, revealing the spur entirely adnate to the ovary (arrow). —E. Detail of the column, with the yellow stigmatic surface indicated by arrow. —F. Column apex at lower left with a detached pollinarium indicated by arrow. Note the brown anther cap.

seriously affected by anthropogenic disturbance due to the establishment of pasturelands, cultivation, and property speculation (Myers et al., 2000). In the Atlantic forest, particularly, numerous species were probably extinct before even being known and thus natural habitats have been lost (Morellato & Haddad, 2000). Currently, the Atlantic Forest is reduced to 4%–8% of its original coverage and the need to preserve these natural areas is urgent.

Specimens examined. BRAZIL. **São Paulo:** Itirapina, Itaqueri da Serra, 22°20′S, 47°52′W, 860 m.s.m., 18 Feb. 2007 (fl.), *A. W. C. Ferreira s.n.* (UEC 148368); Itirapina, Itaqueri da Serra, 22°20′S, 47°52′W, 860 m.s.m., 21 Feb. 2007 (fl.), *A. W. C. Ferreira s.n.* (SPFR 13651).

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Polystichum oblanceolatum, a New Species in Section *Haplopolystichum* (Dryopteridaceae) from Guangxi, China

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ABSTRACT. A new fern species, *Polystichum oblanceolatum* H. He & Li Bing Zhang (Dryopteridaceae), is described and illustrated from a karst cave in Guangxi, southern China. As a member of *Polystichum* Roth sect. *Haplopolystichum* Tagawa, *P. oblanceolatum* is morphologically most similar to *P. dielsii* Christ and *P. liui* Ching, but is distinguishable from the latter two by its often oblanceolate lamina with acute apex, its repand or broadly dentate pinnae with non-spinulose toothed distal margins, and the less developed, more or less truncate, but not sharply acute, basal acroscopic auricles of the pinnae. The new taxon appears to be endemic to a single karst cave in Tian'e County in northern Guangxi and is considered to be Critically Endangered (CR), based on IUCN Red List criteria. A key is provided to facilitate the identification of *P. oblanceolatum* and morphologically similar species.

Key words: China, Dryopteridaceae, Guangxi, IUCN Red List, *Polystichum*.

Species of *Polystichum* Roth (Dryopteridaceae) are widely distributed in the mountains of subtropical and warm-temperate areas in the Northern Hemisphere. Given different circumscriptions of the genus, the superficial similarity of many taxa, and the many under-explored parts across the distribution area, the genus is estimated to contain (180 to)225 to 400 species worldwide (Kramer, 1990; Fraser-Jenkins, 1991; Kung et al., 2001; Wang & Wang, 2001; Lu, 2005), with about 250 or more species estimated in Asia (Benniamin et al., 2008). In China, *Polystichum* is the most species-rich fern genus, with most known species being found in southwestern China and adjacent regions (Kung et al., 2001). Since the publication of the Chinese-language *Flora Reipublicae Popularis Sinicae*, which recognized 168 species in *Polystichum* (Kung et al., 2001), more than 13 new species from southwestern China have been described (cf. Zhang & He, 2012). Our extended fieldwork with respect to the fern flora in Chongqing, Guangxi, Guizhou, Sichuan, and Yunnan in recent years has so far led to the discovery of several new species from limestone areas, most of which are endemic to a single cave or sinkhole (Zhang & He, 2009a, 2009b, 2009c, 2010, 2011, 2012; He & Zhang, 2010, 2011; Zhang et al., 2010). However, the high diversity of *Polystichum* in China, especially in less explored southwestern China, is still far from being well understood.

During fieldwork in 2009, we found a species of *Polystichum* with mostly oblanceolate leaves from a karst cave in Tian'e County, northern Guangxi, China. Herein we describe this as another new cave species of *Polystichum* sect. *Haplopolystichum* Tagawa.

Polystichum oblanceolatum H. He & Li Bing Zhang, sp. nov. TYPE: China. Guangxi: Tian'e Co., Bala (Laopeng) Yaozu Autonomous Township, Madong Village, Zhichang, on weathered crust of limestone rocks at bottom of one of two small caves inside a larger karst cave, 24°48.59′N, 107°03.05′E, ca. 890 m, 13 Nov. 2009, *L. B. Zhang & H. He 5179* (holotype, CDBI; isotypes, CDBI, CTC, MO). Figures 1, 2.

Species *Polysticho liui* Ching et *P. dielsii* Christ affinis, sed ab eis lamina foliari oblanceolata apice acuta, pinnis repandis vel late dentatis marginibus distalibus non spinuloso-dentatis atque auriculis basalibus acroscopicis minus evolutis apice subtruncatis distinguitur.

Plants perennial, evergreen, (2.8–)6.5–9.5 cm tall; rhizome erect, ca. 4.3 × 2.7–4.3 mm with bases of remnant old petioles, sparsely scaly; scales lanceolate, ca. 0.7 × 0.1 mm, dark brown, margins entire;

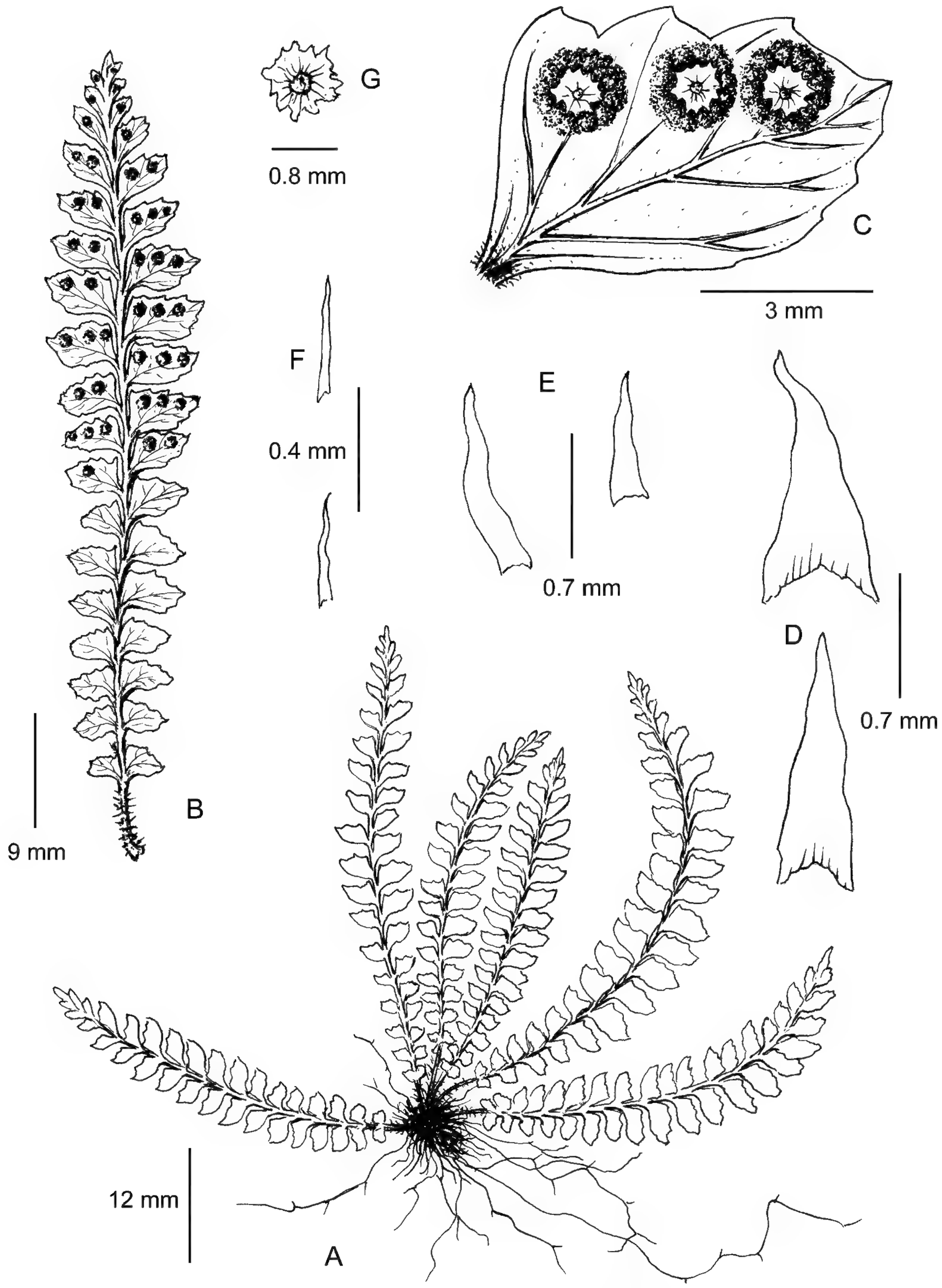

Figure 1. *Polystichum oblanceolatum* H. He & Li Bing Zhang. —A. Habit. —B. Leaf. —C. Pinna. —D. Basal petiole scales. —E. Rachis scales. —F. Pinna microscales. —G. Indusium. Drawings taken from the isotype, *L. B. Zhang & H. He 5179* (CDBI).

roots dull brown when dry, to 11.5 cm, 0.2–0.4 mm diam. Leaves caespitose, 5 to 12 leaves tufted around rhizome, (2.7–)6.3–9.4 cm; petiole stramineous, 0.8–1.4 cm, 0.7–1 mm diam. at middle, adaxially canaliculate, moderately scaly; scales on basal petiole lanceolate to narrowly ovate, chartaceous, 1.4–1.7 × 0.5–0.7 mm, dark brown with narrow, lighter-colored margins when fresh, but matte brown throughout when dry, margins nearly entire; scales on distal petiole similar, but thinner and narrower, to 1.6 × 0.4 mm, brown; leaf lamina oblanceolate, 1-pinnate, (2.3–)4.5–8.5 × 0.9–1.7 cm, apex acute or shortly acuminate, gradually narrowing in basipetal third; rachis 0.5–0.7 mm diam. at middle, apex

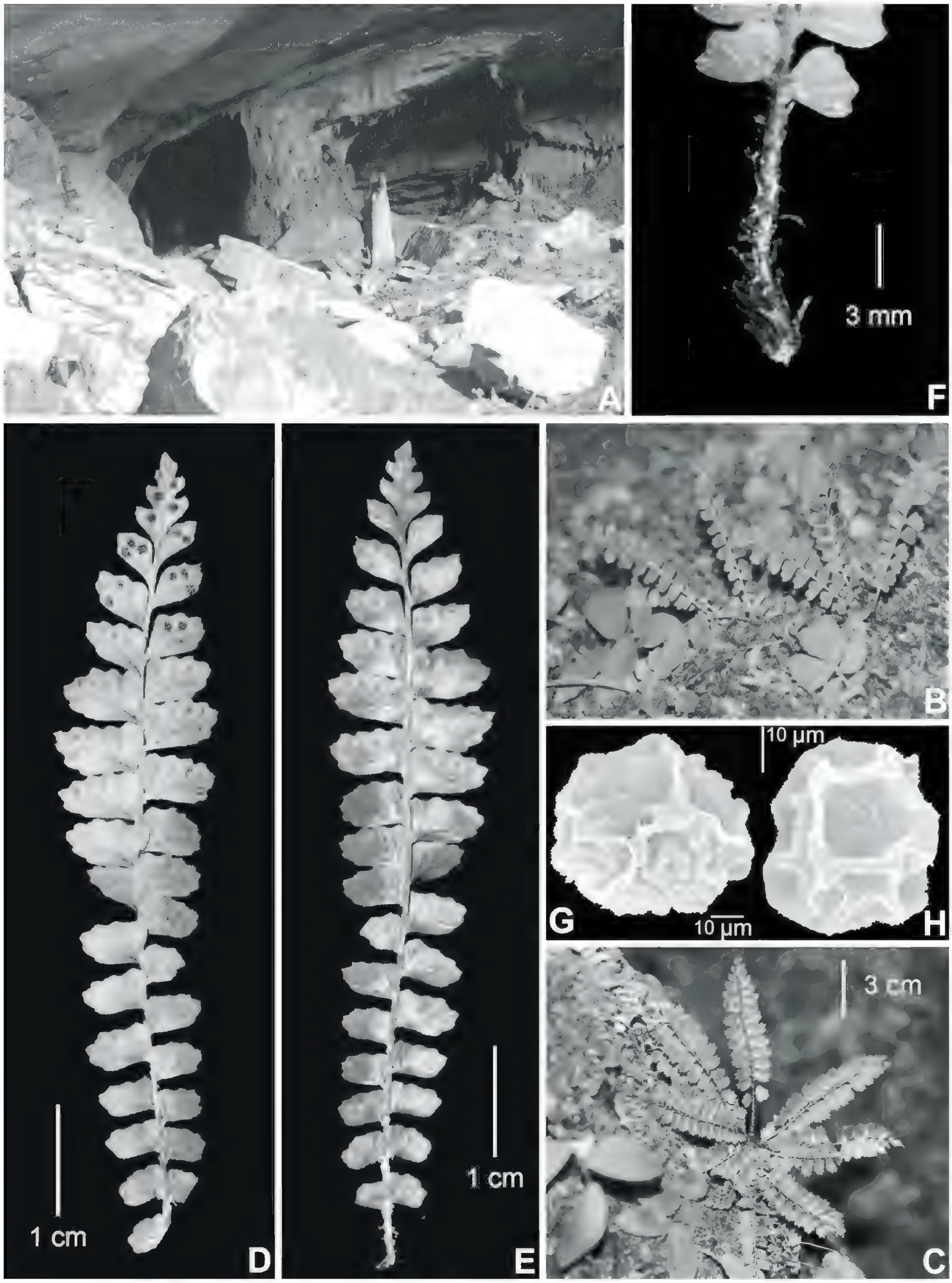

Figure 2. A–G. *Polystichum oblanceolatum* H. He & Li Bing Zhang. —A. Inside view of the karst cave in Tian'e County, northern Guangxi, China, about 15 m from the entrance where *P. oblanceolatum* was discovered. —B. Habit of two individuals accompanied by *Elatostema* J. R. Forst. & G. Forst. —C. Habit of a larger individual. —D. Abaxial view of lamina. —E. Adaxial view of lamina. —F. Basal portion of leaf. —G. SEM micrograph of equatorial view of spore, taken from the isotype, *L. B. Zhang & H. He 5179* (CDBI). —H. *Polystichum dielsii* Christ. SEM micrograph of equatorial view of spore, taken from *L. B. Zhang et al. 751* (MO).

without proliferous bulbils, green, concolorous with pinnae when fresh, stramineous when dry, adaxially sulcate, sparsely scaly abaxially; rachis scales narrowly lanceolate, pale brown, 0.7–1.4 mm, base 0.1–0.3 mm wide, variable in size, but not dilated at base, thinly chartaceous, margins entire, apex subulate; pinnae (5 to)10 to 16 pairs, 4.5–7.8 × 3–4.6 mm, oblong, approximately reaching or slightly imbricate for pinnae in upper middle of lamina, firmly chartaceous, shortly petiolate, petiolules 0.3–0.8 mm, at angles of 70°–90° with rachis, alternate, basal 1 to 3 pinna pairs nearly fan-shaped, bases round to broadly cuneate with acroscopic side being slightly wider, distally repand, with 3 to 5 broad teeth, these occasionally short mucronate; upper pinnae pairs mostly oblong but asymmetric from midribs with acroscopic sides being much broader and slightly auriculate at base, both acroscopic and basiscopic bases nearly truncate, apex acute, distal acroscopic side of pinnae repand or with 3 sinuate teeth, distal basiscopic side mostly with 1 or 2 short broad teeth; adaxial surfaces of pinnae lustrous green when fresh, dull stramineous when dry, glabrous, abaxial surface matte and slightly paler, sparsely covered with scales along veinlets; microscales of pinnae narrowly lanceolate, brown, 0.4–0.6 × 0.01–0.07 mm at base, not dilated at base (narrow-type microscales); venation pinnate, visible abaxially and somewhat obscure adaxially, lateral veins free, single or forked. Sori primarily restricted to distal half of lamina, terminal on lateral veins of pinnae, (1 to)3 to 4(to 6) in 1 row on acroscopic side of pinnae, with only 1 sorus occasionally evident on distal basiscopic side; sori 0.7–1.3 mm diam., 0.6–1.1 mm apart, submarginal, center of sorus 0.3–1.1 mm from pinna margin; indusia peltate, ca. 0.8 mm diam., membranous, pale brown, margins irregularly lacerate; sporangia almost round, ca. 0.3 mm diam., ca. 0.1 mm thick, dark brown when mature; annuli with 11 to 14 thickened cells; stalks ca. 0.3 mm; spores elliptic in equatorial view, perispore sculpture cristate with numerous spinules, 0.3–0.4 μm tall, and perforations ca. 0.13 μm diam.

Distribution and ecology. *Polystichum oblanceolatum* is endemic to northern Guangxi, China, and is so far only known from a single cave in karst topography in Tian'e County. The fern was not found in our subsequent expeditions to caves in neighboring counties in 2010. The new taxon was observed among the weathered crust of limestone rocks at the bottom of one of the two smaller caves inside a large one, growing about 15 m from the entrance of the large cave, closely associated with several species of *Elatostema* J. R. Forst. & G. Forst. (Urticaceae) and unidentified mosses. Other fern and lycophyte species occurring in the same cave included *Asplenium pulcherrimum* (Baker) Ching ex Tardieu, *A. unilaterale* Lam. (Aspleniaceae), *Cyrtomium fortunei* J. Sm., *Polystichum minimum* (Y. T. Hsieh) Li Bing Zhang (Dryopteridaceae), *Pteris deltodon* Baker, *P. henryi* Christ (Pteridaceae), and an undetermined *Selaginella* P. Beauv. (Selaginellaceae). Seed plants found in the same cave include species of *Ficus* L., *Gynostemma* Blume (Curcurbitaceae), *Ophiorrhiza* L. (Rubiaceae), *Pilea* Lindl. (Urticaceae), *Rubus* L. (Rosaceae), and *Tetrastigma* (Miq.) Planch. (Vitaceae).

IUCN Red List category. The type population of *Polystichum oblanceolatum* of approximately 37 individuals was scattered across limestone rocks and occupied a total area of about 10 m^2. According to the IUCN Red List criteria (IUCN, 2008), *P. oblanceolatum* is classified as Critically Endangered (CR). The cave site where this new fern was discovered is just to the side of an intercounty road, and part of the larger cave mouth has been destroyed as a result of the construction of this road. Further expansion of this road may obliterate the habitat of this species.

Etymology. The specific epithet *oblanceolatum* is from the Latin, which refers to the overall shape of the leaf lamina of the new species.

Taxonomic relationships. Preliminary molecular analysis (Zhang, unpublished) from DNA sequences of the chloroplast *trnL-F* intergenic spacer reveals *Polystichum oblanceolatum* to be closely related to both *P. dielsii* Christ and *P. liui* Ching, but it is morphologically conspecific with neither species. Based on ca. 400 *trnL-F* sequences within the genus, *P. oblanceolatum* shares its *trnL-F* sequence with *P. dielsii* and *P. liui*. *Polystichum oblanceolatum* does share a few morphological similarities with *P. dielsii* and *P. liui* in the generally oblong outline of individual pinnae and its chartaceous and adaxially lustrous green lamina. Both *P. dielsii* and *P. liui* are in the same section *Haplopolystichum* as *P. oblanceolatum*. However, *P. oblanceolatum* differs from *P. dielsii* and *P. liui* morphologically by its general oblanceolate shape of the leaf lamina with acute apex, and its repand or broadly dentate pinnae with toothed distal margins that are not spinulose. The new species typically has fewer than four sori mostly restricted to the acroscopic half of the pinnae. In contrast, both *P. dielsii* and *P. liui* normally have more than six sori per fertile pinna and mostly in two rows on each side of the midrib of the pinnae. The

basal acroscopic auricles of pinnae in *P. oblanceolatum* are typically truncate and not acute as in *P. dielsii* and *P. liui*. Field observations revealed that the basal petiole scales of *P. oblanceolatum*, when fresh, are much darker than those of *P. liui*, but this feature became impossible to discern when the specimens were dried, in which case the scales of both species are dull brown. The distinction between *P. oblanceolatum* and *P. dielsii* is more obvious. The latter taxon is normally much larger in size (with leaves to 50 cm and petioles to 15 cm), with the widest part of the lamina of *P. dielsii* close to the lamina base or much below the middle for lamina that are either elliptic or lanceolate in outline. The basal petiole scales of *P. dielsii* are much thicker in texture and obviously bicolorous with lighter brown, narrow margins, and its pinnae have round apex and spiny margins.

Palynologically, both *Polystichum dielsii* and *P. oblanceolatum* have a cristate perispore sculpture with numerous spinules. In contrast, there are many perforations (ca. 0.13 μm diam.) on the perispore of *P. oblanceolatum* (Fig. 2G), while there are none on that of *P. dielsii* (Fig. 2H). Additionally, there are more spinules on the perispore of *P. oblanceolatum* and they are 0.3–0.4 μm tall. The spinules on the perispore of *P. dielsii* are 0.5–0.7 μm tall. The perispore sculpture of *P. liui* is unknown.

Morphologically similar species of *Polystichum oblanceolatum* include *P. cavernicola* Li Bing Zhang & H. He, *P. jinfoshanense* Ching & Z. Y. Liu, *P. lanceolatum* (Baker) Diels, *P. liboense* P. S. Wang & X. Y. Wang, and *P. speluncicola* Li Bing Zhang & H. He, of which *P. cavernicola*, *P. liboense*, and *P. speluncicola* are endemic to Libo County, southern Guizhou. According to our own observations and the literature (Kung et al., 2001; Wang & Wang, 2001, 2003; Zhang & He, 2010, 2011, 2012), these eight species can readily be identified with the following key.

KEY TO *POLYSTICHUM OBLANCEOLATUM* AND MORPHOLOGICALLY SIMILAR SPECIES IN CHINA

1a. Pinnae at middle of lamina spinose on distal margins; pinna with the auricles well developed and with a sharply acute tip 2
1b. Pinnae at middle of lamina repand or bluntly serrate on distal margins; pinna with the auricles less developed and with a rounded or broadly acute tip 4
2a. Pinna apex obtuse or acuminate in outline and with several small spines; basal petiole scales thickly chartaceous, firm, obviously bicolorous; microscales of pinnae without dilated base; plants taller than 15 cm, with leaves to 50 cm; endemic to southern China (Guangxi, Guizhou) and northern Vietnam ..... *P. dielsii*
2b. Pinna apex blunt and ending with one spinose tip; basal petiole scales thinly chartaceous, softer, brown or obscurely bicolorous; microscales of pinnae with dilated base; plants normally <15 cm high 3
3a. Pinnae imbricate to each other, oblong, spiny teeth on distal margins with tips pointing toward pinna apex; basal pinnae ± deflexed; endemic to Chongqing, Guizhou, and Hunan ..... *P. liui*
3b. Pinnae separate from each other, nearly square-shaped, spiny teeth on distal margins with tips pointing outward; basal pinnae mostly attached at a right angle with rachis; endemic to Guizhou, Hubei, Hunan, Jiangxi, and Sichuan ..... *P. lanceolatum*
4a. Pinnae thin and chartaceous, with sharp-tipped teeth on distal margins; endemic to Chongqing, Guizhou, Sichuan, and Yunnan .... *P. jinfoshanense*
4b. Pinnae coriaceous or nearly so, repand or with blunt-tipped teeth on distal margins 5
5a. Veins obviously tipped with swollen hydathodes; petiole scales ciliate on margin; endemic to southern Guizhou ..... *P. liboense*
5b. Veins not swollen at termini; petiole scales nearly entire, irregularly lacerate, or ciliate 6
6a. Petiole scales regularly ciliate on margin; microscales broad-type; endemic to southern Guizhou ..... *P. speluncicola*
6b. Petiole scales nearly entire, or irregularly lacerate on proximal margins; microscales narrow-type 7
7a. Rachis scales dense, subulate, with dilated base, 1.6–3.6 mm; petiole 1–2.5 cm; endemic to southern Guizhou ..... *P. cavernicola*
7b. Rachis scales sparse, narrowly lanceolate, without dilated base, 0.7–1.4 mm; petiole 0.8–1.4 cm, endemic to northern Guangxi ..... *P. oblanceolatum*

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Polystichum loratum (Dryopteridaceae), a New Fern Species from Guizhou, China

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ABSTRACT. A new fern species, *Polystichum loratum* H. He & Li Bing Zhang (Dryopteridaceae), is described and illustrated from limestone cliffs in northern Guizhou Province, China. *Polystichum loratum* is most similar to *P. yaanense* Liang Zhang & Li Bing Zhang in having narrowly ovate to lanceolate abaxial rachis scales. The new species is distinguished by its lorate leaf lamina, the oblong to narrowly ovate microscales (broad-type) on abaxial pinna surfaces, and the exindusiate sori, while *P. yaanense* has lanceolate leaf lamina, subulate microscales (narrow-type) on abaxial pinnae, and indusiate sori. *Polystichum loratum* is considered to be Critically Endangered (CR), based on IUCN Red List criteria.

Key words: China, Guizhou, IUCN Red List, limestone flora, *Polystichum*.

In the summer of 2011, Hai He and Yong-Qing Yang conducted fieldwork in northern Guizhou, China, to search for samples of *Hypodematium glandulosum* Ching ex K. H. Shing (Dryopteridaceae or Hypodematiaceae). On the way to the summit of Jindingshan of Zunyi City, a city famous for the 1935 Zunyi Meeting in modern Chinese revolutionary history, a species of *Polystichum* Roth (Dryopteridaceae) growing on limestone cliffs was collected and photographed, and photos, specimens, and DNA samples were sent to Li-Bing Zhang. After comparative morphological investigation, we conclude that the species is unknown to science, and it is described here.

Polystichum loratum H. He & Li Bing Zhang, sp. nov. TYPE: China. Guizhou Province: Zunyi Prefecture, Zunyi City, Jindingshan Town, Xintugou Cun, Jiayanwo, 27°46′11.02″N, 106°46′14.27″E, 1150 m, on shaded & damp limestone cliffs, 2–3 m distant from the ground, 23 June 2011, *H. He & Y. Yang 1361* (holotype, CDBI; isotypes, CTC, MO). Figure 1.

Diagnosis. *Polystichum loratum* H. He & Li Bing Zhang is most similar to *P. yaanense* Liang Zhang & Li Bing Zhang in having narrowly ovate to lanceolate abaxial rachis scales, but the new species is distinguished by its lorate leaf lamina (vs. lanceolate in *P. yaanense*), the oblong to narrowly ovate and broad-type microscales (vs. subulate and narrow-type in *P. yaanense*) on abaxial pinna surfaces, and the exindusiate sori.

Plants perennial, caespitose, evergreen; rhizome ascending, 0.5–2.2 cm, 0.4–1.6 cm diam., with remnant bases of old petioles, scaly at the base of the petiole (but scales mostly worn out, incomplete, and much darker in color); adventitious roots dull brown when dry, 0.2–0.3 mm diam., nearly glabrous or occasionally covered with lanate scales, the longer roots once or twice branched with lateral rootlets to 1.8 cm. Leaves 8 to 18(to 25) per rhizome, (5.9–) 11.2–16.8 cm, leaf lamina appressed to substrate or ascending; petioles green, (0.5–)1.5–4.8 cm, 0.3–1.2 mm diam. at middle, densely covered with spreading scales; petiole scales generally 2.5–4.1 × 0.8–1.2 mm, ovate to lanceolate, thin and papery, brown, apex caudate, ending in a ca. 0.8 mm hairlike tip, base rounded and slightly peltate in attachment, scale margins with 0.5–0.8 mm wavy, hairlike outgrowths, mixed with smaller scales (fewer and mostly on adaxial petiole surface) deltoid to lanceolate, ca. 2 × 0.5 mm, margins and apex also with hairlike outgrowths and long hairlike tip; basal petiole scales worn and incomplete, similar to those on rhizome, mostly without marginal outgrowths and hairlike tips, thicker in texture and dark brown in color. Leaf lamina lorate, 1-pinnate, (4.5–)7.5–12.5 × 0.9–1.5 cm, apex acuminate, ± narrowed toward base from the mid-portion and tapering down; rachis 0.3–0.6 mm diam. at middle of lamina, without proliferous bulbils, green and concolorous as pinnae when fresh, yellowish green

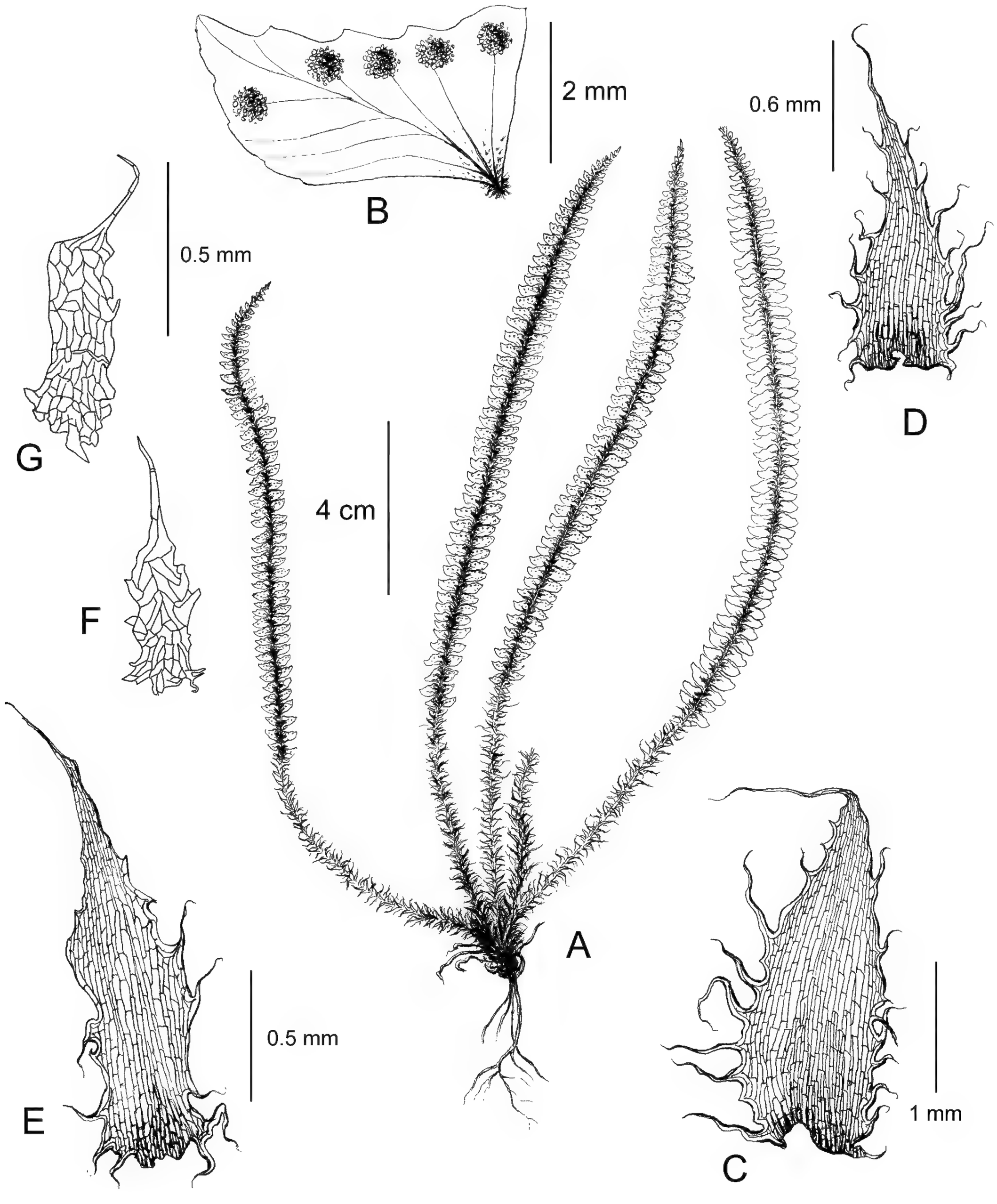

Figure 1. *Polystichum loratum* H. He & Li Bing Zhang. —A. Habit. —B. Pinna. —C, D. Petiole scales. —E. Abaxial rachis scale. —F, G. Microscales (broad-type microscales) of pinnae. A–G drawn from the holotype *H. He & Y. Hang 1361* (CDBI).

when dry, densely covered with scales abaxially, sparsely scaly (especially at base of petiolules) adaxially; abaxial rachis scales ovate to lanceolate, similar to those of petiole but smaller, lighter in color and thinner in texture, adaxial rachis scales deltoid and subulate, dark brown, to 2 × 0.4 mm, hairlike outgrowths only at broadest base, margins nearly entire, apex caudate; pinnae nearly leathery, in (16 to)25 to 55 pairs, alternate, 1–2 mm apart, contiguous or imbricate (sometimes basal 1 to 6 pairs to 3 mm apart even if other pinnae are imbricate), asymmetrically rectangular to oblong (or slightly falcate toward apex), 3.5–6.5 × 1.8–3 mm, lowest pairs usually 1/2 to 2/3 as long as middle pinnae, asymmetrically deltoid or widely so, shortly petiolulate (petiolules to ca. 1 mm, attached to rachis at an acroscopic angle of ca.

60°), basiscopic margins at angles of 75°–150° with rachis, the basiscopic base cuneate, acroscopic side ± truncate (with a blunt auricle, sometimes auricle deeply incised to near midrib and forming a basal free cuneate-based lobe of ca. 2 × 1.8 mm with 2 or more small teeth at apex), forming angles of 90°–120° at the point of attachment to the petiolule, margins slightly cartilaginous, basiscopic side of pinnae nearly entire, distally curved toward apex, with 1 or 2 small teeth (distal margins sometimes curved with 2 to 3 undulations), acroscopic side of pinnae with 3 or 4 shallow teeth between the basal auricle tooth and pinna apex (sometimes also with 3 or more shallow or rarely deep undulations), apex rounded or acute (occasionally acuminate) and ending in a blunt tooth, all teeth without aristate tips, adaxial pinna surface glabrous (occasionally with 1 to 3 microscales), abaxial pinna surface sparsely covered with microscales (especially along veins); microscales oblong to narrowly ovate (Fig. 1F, G; broad-type microscales), 0.8–1.2 × 0.15–0.25 mm, light brown, membranous, apex extended by hairlike appendage, microscale margins irregularly erose, with the broadest part consisting of 6 to 8 lines of cells; venation of pinnae pinnate, visible abaxially and indistinct adaxially, lateral veins free, single or once forked. Sori terminal on lateral veins, 2 to 4(5) on acroscopic side, 0 or 1 on distal basiscopic side, 1.4–2.4 mm diam., mostly medial (between pinna margins and midrib), proximal 1 or 2 sori closer to pinna margins, occasionally all sori close to pinna margins, centers ca. 1.5 mm apart from one another, contiguous when mature; indusia absent; sporangia round, ca. 0.2 mm diam., walls ca. 0.1 mm thick, dark brown when mature; annuli with ca. 15 thickened cells; sporangial stalks ca. 0.3 mm; number of spores per sporangium unknown.

Distribution and ecology. *Polystichum loratum* is currently known only from Xintugou, an area close to Jindingshan Town north of Zunyi City in northern Guizhou. Jindingshan is a scenic mountain near Zunyi, and the area called Xintugou lies within a valley at the western portion of the mountain range; the northern side of Xintugou includes elevated limestone cliffs, where *P. loratum* is found. The areas surrounding Xintugou correspond to a general karst landscape, but without so many limestone outcrops. Given the similarity of the adjacent karst topography to the Xintugou area, we expect that similar habitats, and thus the same plants, could possibly be found during future fieldwork.

Polystichum loratum was observed to grow either on shaded, damp limestone cliffs of a small gorge (Jiayanwo, the type locale) or on unshaded, damp cliffs under shrubs, as well as on the surfaces of carbonate sediment at the bottom of the mouth of a karst cave (Touniudong, Buffalo-Stolen Cave), at 1150–1300 m.

Plants associated with the type of *Polystichum loratum* include the seed plants *Boehmeria clidemioides* Miq. var. *diffusa* (Wedd.) Hand.-Mazz. (Urticaceae), *Briggsia mihieri* (Franch.) Craib (Gesneriaceae), *Elatostema involucratum* Franch. & Sav. (Urticaceae), *Hemiboea subcapitata* C. B. Clarke (Gesneriaceae), *Saxifraga stolonifera* Curtis (Saxifragaceae), *Begonia* L. (Begoniaceae), *Petrocosmea* Oliv. (Gesneriaceae), and *Polygonum* L. (Polygonaceae). Fern associates were *Hypodematium crenatum* (Forssk.) Kuhn (Hypodematiaceae), *Cyrtomium fortunei* J. Sm., *Polystichum craspedosorum* (Maxim.) Diels, and *P. erosum* Ching & K. H. Shing (Dryopteridaceae).

IUCN Red List category. Only four populations of *Polystichum loratum* have been found at Xintugou, with a total of an estimated 180 individuals (with the smallest population having ca. 30 individuals). The new species clearly should be classified as Critically Endangered (CR), based on current information and according to IUCN Red List criteria (IUCN, 2008). However, a more extensive search is needed to accurately assess the conservation status of the new species.

Etymology. The species epithet is taken from the Latin word "loratum," meaning "lorate," referring to the general lorate outline of its lamina.

Taxonomic notes. *Polystichum loratum* has 1-pinnate leaves and is clearly a member of *Polystichum* sect. *Haplopolystichum* Tagawa (1940) s.l. (Zhang & He, 2009). The narrow strap-shaped, lorate outline of the leaf lamina of *P. loratum* is reminiscent of that of *P. subacutidens* Ching ex L. L. Xiang, which is in the same section and is distributed from southern China to northern Vietnam. However, *P. subacutidens* has filiform rachis scales and linear or filiform microscales on pinnae that clearly differ from the new species. In *Polystichum* sect. *Haplopolystichum* s.l., *P. loratum* is one of only two species with ovate to lanceolate rachis scales. The other species in the section with ovate to lanceolate rachis scales is *P. yaanense* (Zhang et al., 2012). In spite of the similar shapes of the rachis scales, these two species can be easily distinguished morphologically from each other. Most important, *P. loratum* has oblong to lanceolate

microscales on pinnae abaxially and exindusiate sori, while *P. yaanense* has subulate microscales on pinnae abaxially and indusiate sori. In addition, *P. loratum* has linear leaf lamina and slightly cartilaginous pinna margins, while *P. yaanense* has lanceolate leaf lamina and noncartilaginous pinna margins. *Polystichum yaanense* occurs in Ya'an Prefecture, Sichuan. The morphological differences between *P. loratum* and *P. yaanense* are elaborated in the following key.

KEY TO SPECIES OF *POLYSTICHUM* SECT. *HAPLOPOLYSTICHUM* S.L. WITH OVATE TO LANCEOLATE RACHIS SCALES IN CHINA

1a. Leaf lamina lanceolate; pinnae stiff, nearly transparent when dry with veins being visible adaxially, not cartilaginous on margin; microscales of pinnae subulate; sori indusiate ..... *P. yaanense*

1b. Leaf lamina lorate; pinnae soft, not transparent when dry with veins being indistinct adaxially, slightly cartilaginous on margin; microscales of pinnae oblong to narrowly ovate; sori exindusiate ..... *P. loratum*

Paratypes. CHINA. **Guizhou:** Zunyi City, Jindingshan Town, Xintugou, Dongwan, Touniudong (Buffalo-Stolen Cave), 1300 m, 23 June 2011, *H. He & Y. Yang 1343*, *1345*, *1347*, *1354* (CDBI, CTC); Jiayanwo, 1150–1200 m, 23 June 2011, *H. He & Y. Yang 1356*, *1360* (CDBI, CTC).

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Hoya daimenglongensis (Apocynaceae, Asclepiadoideae), a New Species from Yunnan, China

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ABSTRACT. *Hoya daimenglongensis* Shao Y. He & P. T. Li (Apocynaceae, Asclepiadoideae) from Yunnan Province, China, is described and illustrated. This new species and *H. linearis* Wall. ex D. Don are similar in their linear leaves and terminal inflorescences. *Hoya daimenglongensis*, however, differs from *H. linearis* by the internal surface of the corolla, which is minutely tomentose and not papillose (vs. glabrous or papillose), and the corona lobes, which are white tinged with red (vs. pure white).

Key words: Apocynaceae, Asclepiadoideae, China, *Hoya*, IUCN Red List, Yunnan.

Among the Asclepiadoideae (Apocynaceae), *Hoya caronsa* (L. f.) R. Br. was established as the type of *Hoya* R. Br. by Brown in 1810 (Brown, 1810) and was collected from China (Linnaeus, 1782; Tsaing & Li, 1977). China is a significant center of diversification among *Hoya*, which has a worldwide distribution. Tsiang and Li (1977) recognized 22 species, three varieties, and two forms for *Hoya* in China. Later, Li et al. (1995) described 32 species and one variety in China, of which 17 *Hoya* species were endemic (Gilbert et al., 1995). Three species have since been recently described from Hainan Island, south of China, by He et al. (2009a, 2009b, 2009c), increasing the number of species of *Hoya* in China to 35. India and Malaysia remain major areas of species diversity for *Hoya* in the world, with as many as 74 estimated for New Guinea (Rintz, 1978; Jagtap & Singh, 1999; Forster, 2006). Although the majority of *Hoya* species twine, there are a small number that are pendent, or erect and non-twining, e.g., *H. linearis* Wall. ex D. Don.

Yunnan Province is particularly diverse for Chinese species of *Hoya* (He et al., 2009a). The first author made an interesting collection of a flowering *Hoya* that exhibited a striking pendent habit during a 2009 botanical trip to Damenglong in Yunnan. Based on the field observations, comparison with specimens at CANT, HITBC, IBSC, K, KUN, MO, P, and PE, and literature survey (Hooker, 1885; Costantin, 1912; Tsiang & Li, 1974, 1977; Rintz, 1978; Li, 1994; Gilbert et al., 1995; Li et al., 1995; Forster & Liddle, 1996; Jagtap & Singh, 1999), the collection appears to be a new species of *Hoya*, which is described herein. This new species appears to be allied to the pendent species *H. linearis* that is widely distributed in China, Nepal, India, and Myanmar (Don, 1825; Hooker, 1885; Li et al., 1995; Jagtap & Singh, 1999). The holotype of *H. linearis* was collected from Nepal (Don, 1825), and the linear blades of this species are among the smallest in *Hoya*, no more than 5 cm long and 0.5 cm wide.

Hoya daimenglongensis Shao Y. He & P. T. Li, sp. nov. TYPE: China. Yunnan: Daimenglong, on trees in montane tropical rainforest, 1200 m, 21 Aug. 2009, *S. Y. He 09080216* (holotype, CANT, CANT photo at MO; isotype, CANT). Figure 1.

Haec species *Hoyae lineari* Wall. ex D. Don foliis linearibus ac inflorescentia terminali similis, sed ab ea corollis intrinsecus tomentellis epapillatis atque coronarum lobis albis rubrotinctis ad angulum externum rotundatis differt.

Epiphytic plants, with milky latex; stems pendent to 1 m, green, villose, slender, 0.2–0.3 cm diam.; internodes 2–3 cm. Leaves decussate, fleshy; leaf blades linear, adpressed, 4.5–6 × 0.2–0.5 cm, 0.2–0.3 cm thick; base cuneate, ± acute or mucronate at apex; blades adpressed to stem, villose, green, with the margin revolute, white; blade midrib abaxially

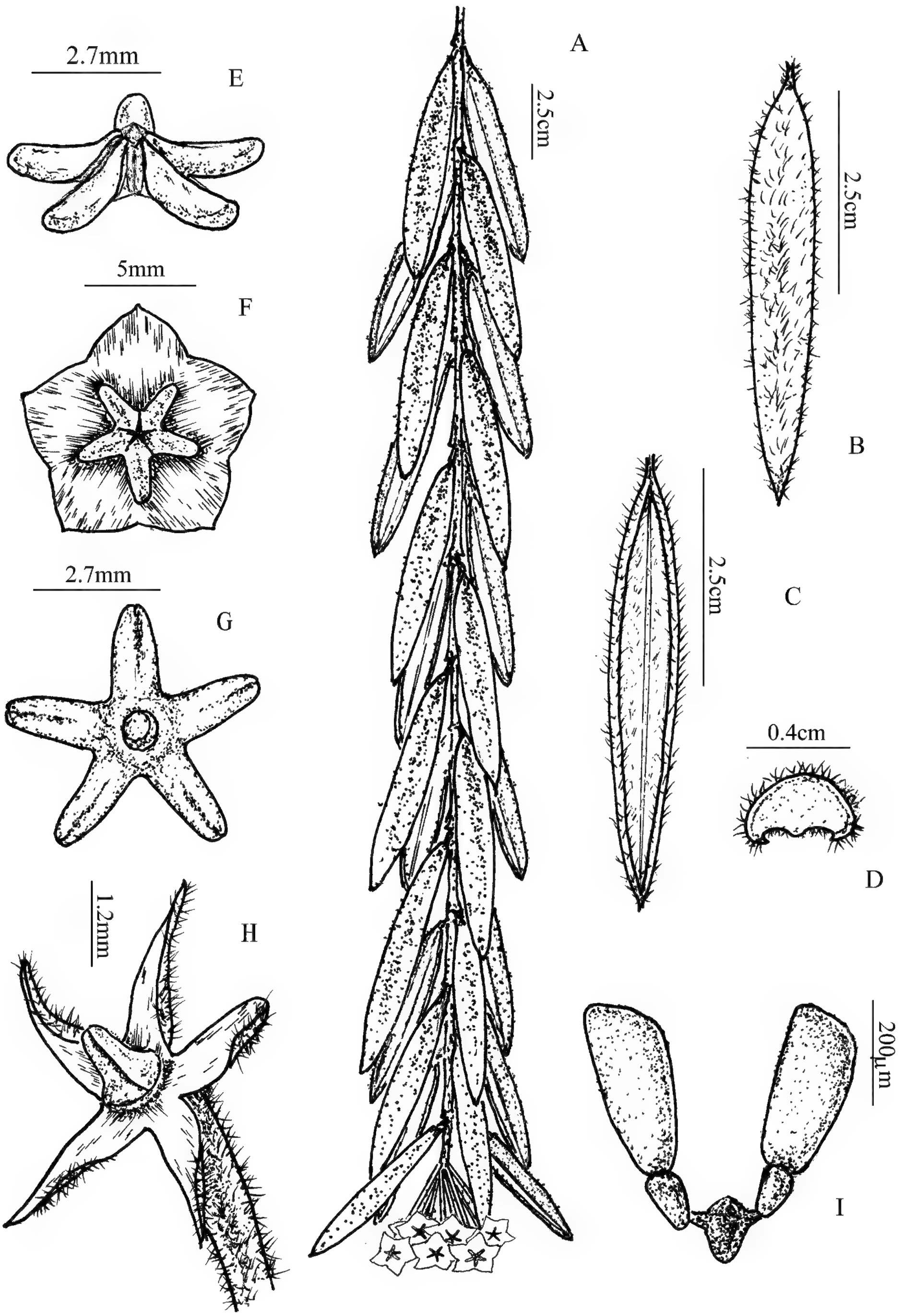

Figure 1. *Hoya daimenglongensis* Shao Y. He & P. T. Li. —A. Fertile, pendent habit. —B. Adaxial leaf blade, showing the pubescent, green, rounded surface. —C. Abaxial leaf blade, showing the white, recurved margins and midrib. —D. Cross section of leaf blade. —E. Side view of corona. —F. Intact flower seen from above. —G. Outer corona. —H. Pedicel, calyx, and ovaries. —I. Pollinarium. A–I drawn from the holotype *S. Y. He 09080216* (CANT) by Shao-yun He.

evident, green; blade adaxially rounded; lateral veins not visible; petiole deep green, villose, brief, only to 0.2–0.3 cm. Inflorescences terminal, pendent, convex pseudoumbels, ca. 9-flowered; peduncle green, villose, ca. 0.4 cm; pedicels yellowish white, villose, 1.5–2 cm. Flowers with the sepals light yellow, externally villose; narrowly triangular, 2.2 × 0.6 mm, apex acuminate; corolla white, externally glabrous, internally minutely tomentose and not papillate, slightly deflexed, ca. 1.2–1.5 cm diam., lobes ca. 2.6–3.2 mm, margins recurved, apex cuspidate; corona with 5 white lobes, but lobes are red-tinged on outer angles and alternate with the lower corolla lobes; lobes resembling rice grains, somewhat cylindrical, ca. 2.5 × 1.1 mm, inner angles erect, subacute, prominent on upper surface, lobe outer angle rounded; stamens 5, adnate to gynostegium, anthers obliquely positioned below the upper corona lobes, with a stigmatic head; pollinium broad, caudicle ca. 75 μm wide, 90 μm high; corpusculum similar, fusiform, dark brown; ovaries paired, superior, 1.3 mm high, 1 mm diam. Fruit and seeds unknown.

Distribution and habitat. *Hoya daimenglongensis* is found in Damenglong, Jinghong City, in southern Yunnan Province, China. The new taxon was observed to grow in tropical montane forest at 1200 m elevation. Associated species include *Horsfieldia tetratepala* C. Y. Wu & W. T. Wang (Myristicaceae); *Wendlandia uvariifolia* Hance (Rubiaceae); *Ficus pumila* L. (Moraceae); *Mallotus nepalensis* Müll. Arg., *Croton tiglium* L., *Mallotus paniculatus* (Lam.) Müll. Arg., and *Glochidion arborescens* Blume (all Euphorbiaceae); *Hicriopteris chinensis* (Rosenst.) Ching (Gleicheniaceae); *Alsophila podophylla* Hook. (Cyatheaceae); *Murdannia triquetra* G. Brückn. (Commelinaceae); *Monstera deliciosa* Liebm. (Araceae); and *Buddleja lindleyana* Fortune (Loganiaceae). Two other species of *Hoya* are recorded from the same area: *H. chinghungensis* (Tsiang & P. T. Li) M. G. Gilbert, P. T. Li & W. D. Stevens and *H. lyi* H. Lév.

IUCN Red List category. *Hoya daimenglongensis* is currently known only from the type locality; beyond this, there is lack of additional information. For now, the species should be classified as Data Deficient (DD), according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Hoya daimenglongensis* was collected with flowers in August. The fresh flowers have a noticeable fragrance.

Etymology. The new species' epithet refers to the type locality in Damenglong, Yunnan Province, China.

Discussion. *Hoya daimenglongensis* is characterized by the internal surface of the corolla being minutely tomentose and lacking papillae, and by the white corona lobes rounded and tinged with red at the outer angles. This species could be most confused with the morphologically similar *H. linearis*, with both taxa having linear and pubescent leaf blades of similar size (slightly shorter in *H. linearis*, 2.5–5 × 0.5 cm), with the entire abaxial surface whitened, but the adaxial surface otherwise green. The two species also share a pendent habit and terminal inflorescences. Petioles are brief, no more than 3 mm, in both species, but villose in *H. tsiangyingiana* and hirsute in *H. linearis*. *Hoya linearis*, however, is easily distinguished by its glabrous or internally papillose corolla, by the corona lobes that are completely white, and by its broader distribution beyond China, ranging into Nepal, India, and Myanmar.

Three species, *Hoya linearis*, *H. chinghungensis*, and *H. lyi*, are sympatric in Yunnan Province with *H. daimenglongensis*. The following key should aid in the identification of the four species.

Key to Four Species of *Hoya* in Yunnan Province, China

1a. Pseudoumbels terminal 2
2a. Leaf blades linear 3
3a. Corolla internal surface glabrous or papillose; outer angles of corona lobes acute, white ..... *H. linearis*
3b. Corolla internal surface tomentose, nonpapillose; outer angles of corona lobes round, tinged red ..... *H. daimenglongensis*
2b. Leaf blade broadly ovate, 1–1.5 cm, lateral veins obsolete ..... *H. chinghungensis*
1b. Pseudoumbels extra-axillary; leaf blades elliptic, oblong, or elliptic-lanceolate, rarely suborbicular, (3–)5.5–19 cm, lateral veins in 4 to 7 pairs ..... *H. lyi*

Paratype. CHINA. **Yunan:** Daimenglong, on trees in montane tropical rainforest, 1200 m, 21 Aug. 2009, *S. Y. He 09080217* (CANT).

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Passiflora unipetala, a New Bat-pollinated Species of *Passiflora* supersect. *Tacsonia* (Passifloraceae)

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Abstract. *Passiflora unipetala* P. Jørg., Muchhala & J. M. MacDougal (Passifloraceae) is described from two cloud forest remnants in Pichincha, Ecuador, and is assigned to the Andean endemic *Passiflora* L. supersect. *Tacsonia* (Juss.) Feuillet & J. M. MacDougal. This new species with yellowish green flowers is distinguished from all other passionflowers by having only one petal. It is pollinated by bats, which is rare in *Passiflora*.

Key words: Bat pollination, Ecuador, IUCN Red List, *Passiflora* supersect. *Tacsonia*, Passifloraceae.

Described within *Passiflora* L. (Passifloraceae), the new species was discovered and first collected by Muchhala in May 2009 while he studied the ecology of flower-visiting bats in Ecuador, and then collected and documented again by him at a different locality in June 2010. The type was collected in June 2009 from the same plant that Muchhala had observed earlier that year. Jørgensen and Ulloa returned again to the type locality in June 2011 and April 2012 to collect more flowering material if possible, but a landslide had destroyed the plant or clone.

This new species in *Passiflora* has only a single petal. This notable character-state has never before been recorded in the genus or even within the family. The petal is large, situated in the uppermost part of the horizontally presented flower, and is well-developed enough to shield the pollen and stigmas from rain. The species is placed in *Passiflora* supersect. *Tacsonia* (Juss.) Feuillet & J. M. MacDougal based on the large verticillate bracts, large flowers with an elongate floral tube longer than the sepals, very reduced corona, pollen with three primary opercula, foveate testa, and 3-lobed serrate leaves with petiolar glands.

Passiflora unipetala P. Jørg., Muchhala & J. M. MacDougal, sp. nov. TYPE: Ecuador. Pichincha: Bellavista Cloud Forest Reserve, next to Research Center entrance, Tandayapa–Mindo rd., turnoff toward Nanegalito, 2350 m, 00°00′47″S, 78°41′12″W, 24 June 2009, *P. M. Jørgensen & C. Ulloa 2486* (holotype, MO; isotypes, QCA, QCNE). Figures 1, 2.

Haec species *Passiflorae ampullaceae* (Mast.) Harms similis, sed ab ea petalo unico, bracteis ovato-ellipticis luteoviridibus, stipulis linearibus integris atque fructu costato triangulari-ellipsoideo differt.

Liana to 6 m; stem cylindrical, drying dark brown with light brown stripes, shoot apex cernuous; internodes 6.8–13.4 cm; indument pale brown translucent, sparingly pubescent, trichomes curly. Stipules linear, 8–10 × 0.8–1 mm, early deciduous, particularly pubescent toward the apex, upper 1/3 pinkish; petioles 2.2–2.9 cm, canaliculate adaxially, pubescent; glands 4 to 6(to 8) adaxially, scattered or occasionally 1 pair and the rest scattered, very reduced in size and possibly nonfunctional, pubescent; leaves trilobed (8–)10–16 cm wide; lobes narrowly ovate, acute; margin serrate, central lobe 8–12.6 × 2.6–4.1 cm, lateral lobes 6–9 × 1.7–2.6 cm; lamina matte to slightly lustrous above, dark green, primary nerves impressed, secondary nerves slightly raised in a depression, and tertiary nerves raised, pubescent only on principal nerves toward the base, trichomes white; undersurface lighter green, densely pubescent, trichomes white translucent along all nerves, surface between nerves glabrous, all nerves prominently raised. Flowers axillary, solitary, horizontal, light yellowish green, with no human-

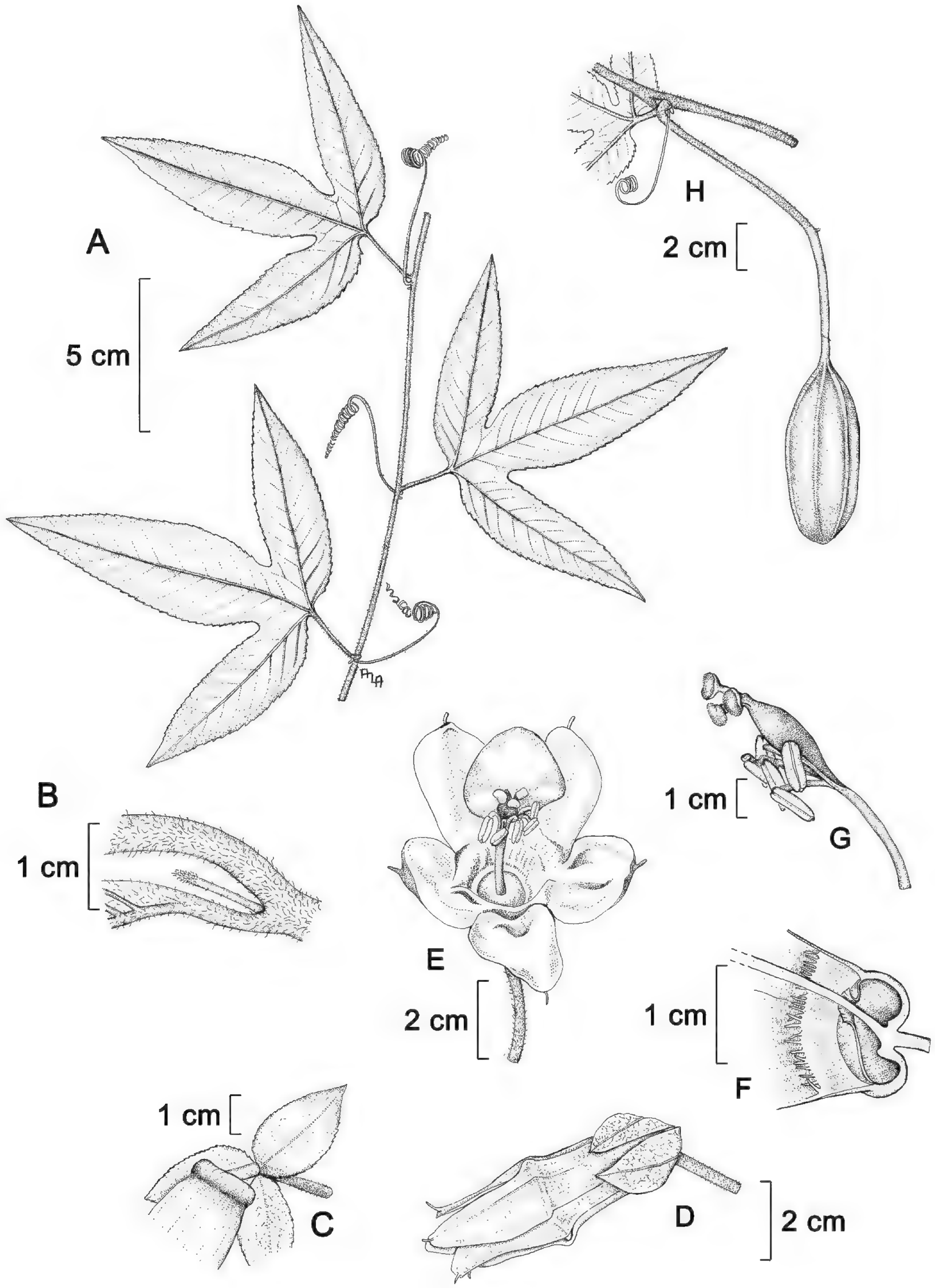

Figure 1. *Passiflora unipetala* P. Jørg., Muchhala & J. M. MacDougal. —A. Habit of leaves, pre-reproductive shoot. —B. Detail of node, showing stipule. —C. Bracts near base of flower at articulation of peduncle. —D. Side view of flower closed after anthesis. —E. Flower, front view; note single petal and dimples at base of lower sepals. —F. Flower, longitudinal section at base of floral tube showing nectary chamber and hypanthium, row of coronal filaments, and operculum membrane near base of eccentric curved androgynophore. —G. Gynoecium and androecium at end of androgynophore. —H. Fruit, habit. A–D, F–G, drawn from the holotype, including photographs of same (*P. M. Jørgensen & C. Ulloa 2486*, MO); E, drawn from photographs of the paratype (*N. Muchhala 303*, MO); and H from photographs of the paratype (*N. Muchhala 450*, QCA).

Figure 2. *Passiflora unipetala* P. Jørg., Muchhala & J. M. MacDougal. —A. Flower and bud in situ, oblique side view. —B, C. The bat, *Anoura fistulata* Muchhala, Mena-Valenzuela & Albuja, feeding at flower during a clinging-type visit. Note thumb-claw and contact of anthers on back of bat. Photos taken by Muchhala at the type locality in Bellavista Cloud Forest Reserve, Pichincha, Ecuador.

detectable odor; peduncles 10.7–13 cm, including portion distal to articulation, no significant elongation in fruit, slightly pubescent, stout and thick, sometimes flushed reddish; bracts 3.3 × 1.5 cm, free, located at articulation 0.9–1.1 cm from hypanthial base, ovate to elliptic, acute, yellow to yellowish green, margins denticulate, teeth occasionally glandular, reticulate venation visible; hypanthium (floral tube) 3.4 cm long, 2 cm wide at apex, 1.2 cm at base, light green to light yellowish green outside, whitish inside; sepals 5 in number, 3–3.4 × 1.7–2 cm, ovate, ridged to folded transversely at base, conspicuously keeled, acute, light yellowish green, aging to a slight reddish or pink flush adaxially as flower closes, aristate subterminally, awn 4–4.5 mm; petal 1, 3.4 × 2(–2.6) cm, ovate, obtuse, light yellowish green; outer corona absent, reduced to a mere irregular ridge at the base of the petals where the outer corona is typically located in tacsonias, inner corona placed ca. 5 mm above base of hypanthium, consisting of ca. 1 mm filiform projections toward the apex of the flower; operculum flat, curved toward apex of flower clasping the androgynophore, margin irregularly denticulate; androgynophore 4 cm, slightly curved, eccentric, white; androecium zygomorphic, presenting pollen downward, free filaments 0.9–1.4 cm, white; anthers yellow; pollen grains subspherical, 46–52 μm diam., coarsely reticulate, with wavy muri, zonocolpate, geminicolpate with 3 pairs of colpi, each pair anastomosing at the poles, forming 3 pseudopercula, secondary opercula absent, 47,110 ± 7622 SE pollen grains per flower; ovary ellipsoid, green, hexagonal to obtusely 6-ridged in cross section, glabrous; styles cream; stigmas light green. Fruit 8.5–9 cm, including 1 cm stipe, 3.3–3.5 cm diam., ellipsoid, 3-ribbed and somewhat triangular in cross section, turning yellowish orange at maturity; seeds 8.7 × 5.1 mm, the testa shallowly foveate near the center of each face.

Distribution. *Passiflora unipetala* is endemic to cloud forests of the northwestern slopes of the Andes of Ecuador. It has been collected at elevations from 1950 to 2350 in two private reserves: Bellavista Cloud Forest Reserve and Bosque Protector Rio Guajalito.

IUCN Red List category. *Passiflora unipetala* is only known from two individuals at two localities about 30 km apart, and the type individual perished in a landslide between 2009 and 2011. The species conforms to IUCN (2001) criteria B, C, and D as Critically Endangered (CR). However, the western slopes of Pichincha at ca. 2000 m elevation are still relatively well preserved, and the two localities are both within privately protected areas.

Ecology and phenology. *Passiflora unipetala* is pollinated by glossophagine bats (Fig. 2); its pollen has been found on the fur of *Anoura caudifer* Geoffroy, *A. geoffroyi* Gray, and *A. fistulata* Muchhala, Mena-Valenzuela & Albuja, in both of the collection sites, as well as at El Pahuma Orchid Reserve at 2000 m (Muchhala & Jarrin-V., 2002; Muchhala et al., 2005). It apparently presents a steady-state (year-long) flowering schedule, as bats have been captured with its pollen throughout the year (including February, March, April, June, July, September, October, and December; Muchhala, unpublished data). During flower visits, bats have been observed to either continue hovering while visiting the flowers in less than a second (supplemental video available from Muchhala), or to briefly cling to the hypanthium with their thumb-claws (e.g., Fig. 2B).

Etymology. The specific epithet refers to the presence of a single petal, reflecting the evolutionary loss of four of five petals, a characteristic unique to this species among the family.

Relationships. *Passiflora unipetala* clearly falls in *Passiflora* supersect. *Tacsonia*, and would key to *P. ampullacea* (Mast.) Harms or *P. coactilis* (Mast.) Killip in the *Flora of Ecuador* (Holm-Nielsen et al., 1988), although it differs from both in only having a single petal (vs. five). *Passiflora unipetala* is quite similar to *P. ampullacea* in its flower color and shape, and might be closely related, but differs by the stipules that have an entire margin (vs. denticulate margin), and by the ribbed, subtriangular fruit (vs. nonribbed and terete in cross section). It differs from the pink-flowered *P. coactilis* by the deeply lobed leaves, free bracts, stout peduncles that hold the yellowish green flowers horizontally, gullet-shaped hypanthium, and ribbed fruits.

Another group of species to consider for relationships and placement of the new species is *Passiflora* sect. *Rathea* (H. Karst.) Harms in *Passiflora* supersect. *Tacsonia*. The species *P. andina* Killip, *P. harlingii* Holm-Niels., and *P. colombiana* L. K. Escobar all have yellowish green to orange or salmon-colored pendent gullet-shaped flowers, a corona series on the inner floral tube wall (occasionally missing), and deeply trilobed leaves. The characteristics that separate them from *P. unipetala* are the five petals inserted below the fused sepals and the fact that the stipules are all linear lanceolate, occasionally serrate, but never linear aciculate.

A logical placement of *Passiflora unipetala* would be near *P. ampullacea* or within *Passiflora* sect. *Rathea*. Both of those taxa share with the new species

the characteristic of cernuous growing-shoot apices, a derived character-state in *Passiflora* supersect. *Tacsonia*. Convergence and reductions could easily be in play here, so the phylogenetic position of *P. unipetala* within *Passiflora* supersect. *Tacsonia* will have to await more detailed analysis. In any case, it appears that this bat-pollinated species has been derived from hummingbird-pollinated relatives in *Passiflora* supersect. *Tacsonia*.

The well-developed single petal is unique. There are a few species of fundamentally apetalous *Passiflora* that occasionally have flowers with only one (or more) small, poorly developed petals, e.g., *P. apetala* Killip, but those petals appear vestigial and only a few millimeters in size. Members of *Passiflora* supersect. *Cieca* (Medik.) J. M. MacDougal & Feuillet have similarly lost all of their petals, although in a few of the species it is occasionally possible to find anomalous single flowers on a plant with one or two petals (MacDougal, 1992; Porter-Utley, 2003).

Passiflora unipetala exhibits a number of characteristics known to be associated with a syndrome of chiropterophily (Faegri & van der Pijl, 1979; von Helverson, 1993), including nocturnal anthesis, a wide flower opening with a gullet- or funnel-shaped floral tube, and a light greenish or yellowish green floral color. However, it lacks the musky or skunky odor typical to bat-flowers; in fact, no odor could be detected. The flower has a particularly undulating surface at its mouth created by folds and indentations in the sepals, including unusual dish-shaped pockets or dimples inside at the base of the sepals (see Fig. 1E). The function of this sculpturing could be to give the flower more physical strength to support the nectar-seeking bat and maintain the mouth of the flower open and accessible. Alternatively, the folds and shapes may have acoustic properties that help the bats to locate the flower, as has been shown recently for other bat-pollinated flowers (e.g., von Helversen & von Helversen, 1999; Simon et al., 2011). *Passiflora* sect. *Rathea* (mentioned above as a possible relative of the new species) also has species with unusual gullet-shaped to somewhat tubular flowers with conspicuous folds and dimples near the mouth, formed by the petals in that case, but their pollinators are unknown. Such dimples are not found in *P. ampullacea*, which after a full night of observation was found to be visited by hummingbirds in the early morning (Escobar, pers. comm.).

With *Passiflora unipetala*, there are now eight out of ca. 575 species of *Passiflora* with flowers known to be bat-pollinated: *P. mucronata* Lam. (Sazima & Sazima, 1978, 1987; Varassin et al., 2001), *P. contracta* Vitta, *P. ovalis* Vell. ex M. Roem. (as *Tetrastylis ovalis* (Vell.) Killip; Buzato & Franco, 1992), an unpublished species in *Passiflora* supersect. *Laurifolia* (Killip ex Cervi) Feuillet & J. M. MacDougal from Venezuela (Vanderplank, 1996), *P. penduliflora* Bertero ex DC. (Kay, 2001), *P. silvestris* Vell. (as *P. galbana* Mast.; Varassin et al., 2001), and *P. trisecta* Mast. (Muchhala, pers. obs.). In addition there are nine species with flowers that appear bat-adapted, although actual pollinator observations are lacking: *P. macropoda* Killip, *P. weberbaueri* Harms, *P. peduncularis* Cav. (Ulmer & MacDougal, 2004), *P. recurva* Mast. (Machado & Vogel, 2004), *P. setacea* DC., *P. hatschbachii* Cervi, *P. andina* Killip, *P. harlingii* Holm-Niels., and *P. colombiana*.

Paratypes. ECUADOR. **Pichincha:** Reserva Bellavista, 30 m from research station on rt. side of rd. to lodge, 2350 m, 00°00′47″S, 078°41′12″W, 30 May 2009, *N. Muchhala 303* (MO); Reserva Rio Guajalito, beginning of Cascadas trail, 1949 m, 00°14′45″S, 078°48′08″W, 24 June 2010, *N. Muchhala 450* (QCA-208301, QCA-7007687).

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Meconopsis xiangchengensis (Papaveraceae), a New Species from Sichuan, China

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Abstract. A new species of Papaveraceae, *Meconopsis xiangchengensis* R. Li & Z. L. Dao, is described and illustrated from southwestern Sichuan, China. The new taxon is placed in *Meconopsis* sect. *Simplicifoliae* (Tayl.) C. Y. Wu & H. Chuang and is morphologically related to *M. impedita* Prain. *Meconopsis xiangchengensis* differs from the latter by the plant height (8–10 cm vs. 15–25 cm in *M. impedita*) with sparse prickles or nearly glabrous on both surfaces (vs. denser prickles), and by the shorter petioles (1–2.5 cm vs. 3–7.2 cm) and styles (2–3 mm vs. 3–10 mm).

Key words: China, IUCN Red List, *Meconopsis*, Papaveraceae, Sichuan.

The Papaveraceae comprise ca. 23 to 26 genera and 230 to 300 species, depending on taxonomic opinion (Mabberley, 1997; Hou, 1998). The family is widely distributed in northern temperate regions, represented by 11 genera, and approximately 62 species occur in China (Wu et al., 2003).

Meconopsis Vig. is composed of ca. 49 species that are distributed in south-central temperate Asia, extending from Chitral and Kashmir along the Himalayas and intervening mountain ranges. Thirty-eight species occur in southwestern China (Wu et al., 1999), and the genus is found in northern Yunnan, southern Tibet and Sichuan into southern Gansu, southern Qinghai, central Shaanxi, and western Hubei provinces (Wu et al., 2006). There is a single species in western Europe, *M. cambrica* Vig., which is the type for the genus and a geographical outlier because it is indigenous to England, Wales, Ireland, and the western seaboard of Europe (Taylor, 1934).

During the summer of 2007, a botanical expedition was carried out in the Hengduan Mountains in western China to study the biodiversity and speciation of alpine plants. One species was collected with morphological features that differed from all those of other known species described for *Meconopsis*. After searching the literature (Taylor, 1934; Wu & Zhuang, 1979, 1980; Zhou, 1979; Long, 1984; Debnath & Nayar, 1986; Yang & Wang, 1990; Wu et al., 1999) and conducting a morphological study and examination of many other specimens (including those at KUN and PE), we conclude that the material found at Hengduan Mountains represents a new species in *Meconopsis*.

Meconopsis xiangchengensis R. Li & Z. L. Dao, sp. nov. TYPE: China. Sichuan: Ganzi Tibetan Autonomous Prefecture, Xiangcheng Co., Shagong township, Wuming Snow Mtns. Pass, alpine meadow on slope, 29°08′15.5″N, 100°02′38.6″E, 4684 m, 19 July 2007, *R. Li & Z. Dao 036* (holotype, KUN). Figure 1.

Species nova *Meconopsidi impeditae* Prain affinis, sed ab ea planta plerumque minore (8–10 cm alta) sparsim setifera aut glabra, petiolis brevioribus (1–2.5 cm longis) atque stylo brevi (2–3 mm longo) differt.

Monocarpic herb, 8–10 cm tall, usually covered at plant base with remnants of persistent leaf bases; tap root stout, elongated, tapering, to 20 cm, to 1 cm diam. Leaves all basal, lamina elliptic or spatulate, 3–5 × 0.5–1.2 cm, apex obtuse, margin entire and sinuate, with sparse yellow-brown prickles or nearly glabrous on both surfaces, green adaxially, glaucous abaxially, midrib conspicuous, lateral veins dichotomous; petioles 1–2.5 cm. Flowering stems 6 to 9, to 10 cm tall, glabrous; flowers terminal, borne singly on slender scape arising basally. Flower with sepals 2, ovate to oblong, 0.9–1.2 × 0.7–1 cm, apex obtuse, with sparse yellow-brown prickles abaxially, sepals falling prematurely; petals 6 to 8, obovate or suborbicular, 1.2–2.5 × 1–1.8 cm, deep purple; stamens numerous; filaments filiform, ca. 7 mm, of the same shade or darker than the petals; anthers

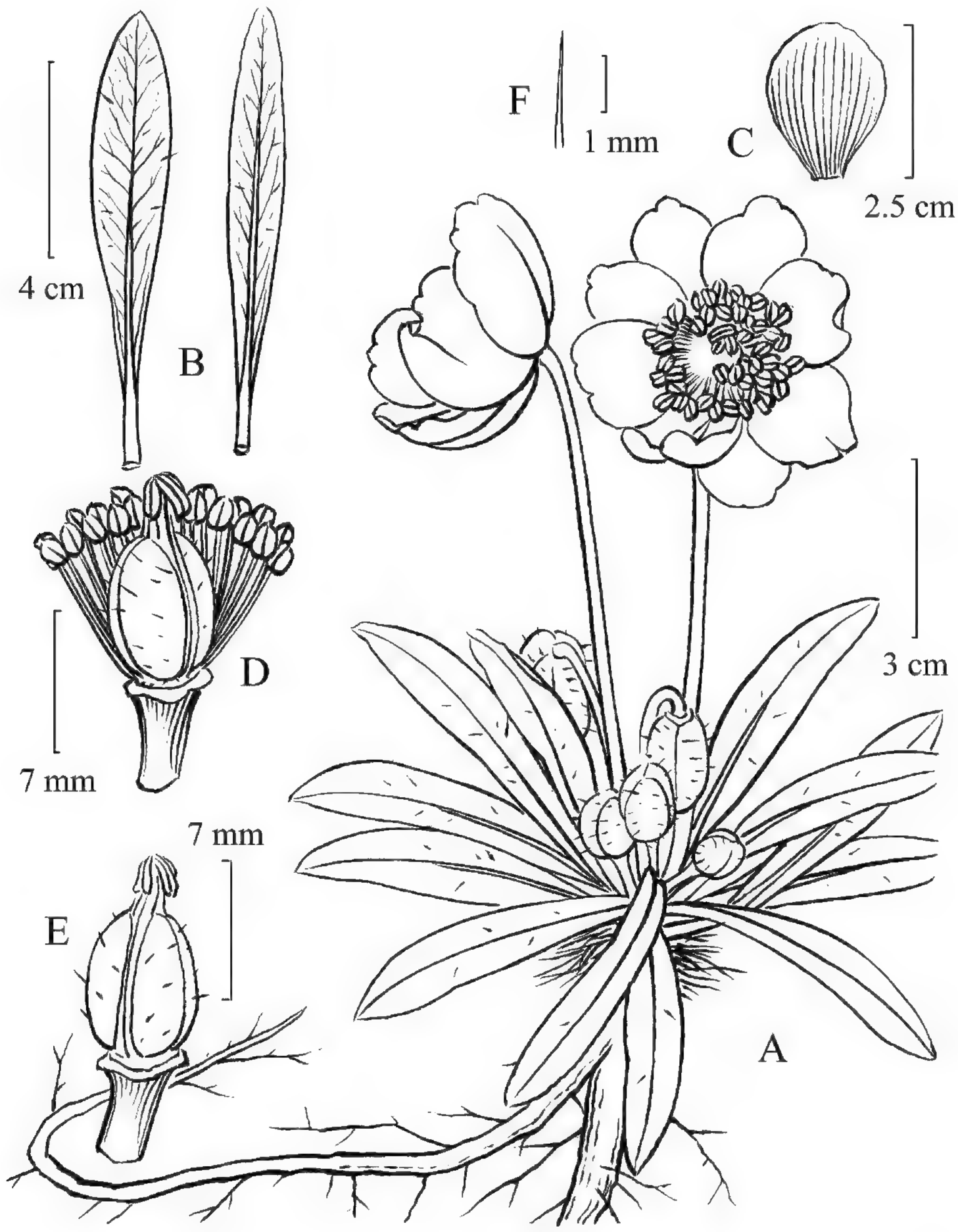

Figure 1. *Meconopsis xiangchengensis* R. Li & Z. L. Dao. —A. Habit. —B. Leaves with sparse yellow-brown prickles on both blade surfaces. —C. Petal, showing venation. —D. Stamens and pistil of flower, with the petals removed. —E. Ovary with sparse yellow-brown prickles. —F. Prickle. Drawn from the holotype *R. Li & Z. Dao 036* (KUN).

ovate, ca. 1 mm, yellow; ovary ellipsoid-oblong, ca. 7 mm, with sparse yellow-brown prickles or almost glabrous; style slender, 2–3 mm, stigma capitate, cream colored. Fruit not seen.

Distribution and habitat. *Meconopsis xiangchengensis* is currently known only from two sites in the southern Hengduan Mountains, in alpine meadows, at altitudes of 4385–4700 m. The type locality is in Xiangcheng County of southwestern Sichuan Province and the second site is to the south, in Shangri-La County of northwestern Yunnan Province, China. The new species may be considered endemic to these Hengduan Mountain localities.

IUCN Red List category. *Meconopsis xiangchengensis* was collected only from two sites and is therefore assumed to be rare. It is considered Endangered (EN), according to IUCN Red List criteria (2001), since its known area of occupancy is less than 500 km^2 (criterion B2) and the total population size is estimated to be smaller than 2500 mature individuals (criterion C).

Phenology. *Meconopsis xiangchengensis* was observed with flowers in July.

Etymology. The specific epithet of the new species refers to the type locality, Xiangcheng County in Sichuan Province, China.

Discussion. According to Wu and Zhuang (1980), Wu et al. (1999), and Taylor's (1934) monographic work, *Meconopsis xiangchengensis* obviously belongs to *Meconopsis* sect. *Simplicifoliae* (Tayl.) C. Y. Wu & H. Chuang in *Meconopsis* ser. *Delavayanae* Tayl. The

section is characterized by the flowers borne singly on slender basal scapes, with six to eight deep purple petals. The series is characterized by a stout and elongated tap root, and the plants are usually covered at the base with remnants of persistent leaf bases. The new species is closely related to *M. impedita*, but differs from the latter by the plants being shorter (8–10 cm vs. 15–25 cm in *M. impedita*) with sparse prickles or glabrous (vs. denser prickles). The petioles of *M. xianghengensis* are shorter (1–2.5 cm vs. 3–7.2 cm), as are the styles (2–3 mm vs. 3–10 mm). The new species was collected within the general range of *M. impedita*, and the two species may be considered sympatric. *Meconopsis impedita* also occurs in alpine meadows on slopes and pastures, at similar elevations (3400–3700 m), although *M. impedita* has been collected at lower sites than the new species. *Meconopsis impedita* is known from southwestern Sichuan, southeastern Xizang, and northwestern Yunnan provinces in China (Zhang & Grey-Wilson, 2008).

Paratypes. CHINA. **Sichuan:** Ganzi Tibet Autonomous Prefecture, Xiangcheng Co., Shagong township, Wuming Snow Mtns. Pass, alpine meadow on slope, 29°08′15.5″N, 100°02′38.6″E, 4684 m, 19 July 2007, *R. Li & Z. Dao 039* (KUN). **Yunnan:** Diqing Tibet Autonomous Prefecture, Shangri-La Co., Geza township, near Landdu pass, alpine meadow on slope, 28°08′23.7″N, 99°54′28.8″E, 4385 m, 16 July 2007, *R. Li & Z. Dao 009C* (MO).

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Dryopteris jiucaipingensis (Dryopteridaceae), a New Species in *Dryopteris* sect. *Hirtipedes* from Guizhou, China

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ABSTRACT. A new fern species, *Dryopteris jiucaipingensis* P. S. Wang, Q. Luo & Li Bing Zhang (*Dryopteris* Adans., sect. *Hirtipedes* Fraser-Jenk.; Dryopteridaceae), is described and illustrated from northwestern Guizhou, China. *Dryopteris jiucaipingensis* is most similar to *D. lunanensis* (Christ) C. Chr., but the former taxon has light brown rachis scales and occurs in alpine regions (at an elevation of 2580 m), while the latter has nearly black rachis scales and is found in montane and lowland areas (below 900 m).

Key words: China, *Dryopteris*, Guizhou, IUCN Red List, section *Hirtipedes*.

In the summer of 2011, Qiang Luo conducted fieldwork in Jiucaiping (the Leek Terrace), the highest peak in Guizhou Province, China. Specimens of a species of *Dryopteris* Adans. (Dryopteridaceae) collected on this trip drew his attention, and he then showed these specimens to Pei-Shan Wang. After extensive morphological study, he concluded that the species was morphologically similar to, but different from, *D. lunanensis* (Christ) C. Chr. Later, photographs and DNA material were sent to Li-Bing Zhang. Our morphological study suggests that the species of *Dryopteris* from Jiucaiping represents an undescribed species, which we describe herein.

Dryopteris jiucaipingensis P. S. Wang, Q. Luo & Li Bing Zhang, sp. nov. TYPE: China. Guizhou: Hezhang Co., Zhushi Yi Autonomous Xiang, Luobu Stone Forest Sinkhole, 26°49′17.76″N, 104°44′8.19″E, acidic soil, 2580 m, 2 Oct. 2011, *Q. Luo 1061* (holotype, CDBI; isotype, BJ). Figure 1.

Diagnosis. *Dryopteris jiucaipingensis* P. S. Wang, Q. Luo & Li Bing Zhang is most similar to *D. lunanensis* (Christ) C. Chr., but the former is distinguished by leaf blades of 63–68 × 24–27 cm and light brown rachis scales, while the latter has leaf blades of ca. 48 × 30 cm and nearly black rachis scales.

Plant perennial, caespitose, 1.1 m tall or taller; rhizome erect, ca. 6 cm, 1.4–2 cm diam., glabrous; petiole 44–45 × 0.8–1 cm at base, dark brown and glabrate at base, light brown and scaly acropetally; petiole scales narrowly lanceolate and filiform, light brown, margin slightly ciliate. Leaves 15 to 20 per rhizome, blades oblong to narrowly ovate, 1-pinnate, 63–68 × 24–27 cm at middle, slightly contracted toward base, abruptly narrowed to a pinnately acuminate apex; rachis 3–4 mm diam., light brown, with dense, narrowly lanceolate to linear, filiform scales, ca. 7 × 0.9 mm; pinnae in 20 to 25 pairs, narrowly elliptic, herbaceous or thinly papery, slightly ascending, basal 2 or 3 pairs opposite, the upper pairs alternate, lobed shallowly to lobed halfway to pinna rachis (sometimes pinnatipartite at pinna bases), acuminate at apex, symmetric and broadly cuneate or shallowly cordate at base, stalked; pinnae at mid-portion of leaf blade largest, 13–14 × 2.5–3 cm; pinnae in lower portion of leaf blade slightly contracted; basalmost pinnae 10–12 × 2.5–3 cm; pinnae adaxially dark green when dry, glabrous, abaxially yellowish green, with sparse microscales; microscales brown, hairlike, ca. 0.4 mm; pinna rachis sparsely with filiform scales; pinna lobes to 15(to 20) pairs, oblong, obtuse and toothed at apex, entire laterally; venation pinnate, lateral veins unbranched on lobes, those on adaxial surface glabrous, those on abaxial surface ± with filiform scales. Sori 0.8–1.2 mm diam., 1–2.8 mm apart from each other, round in shape, in multiple rows on each side of pinna rachis, 1 row on each side of vein on lobes, 2 to 5 per row; sporangia 0.08 mm diam.; indusia reniform, 0.4–0.8 mm diam., thin, yellowish green when young, dark brown when mature, persistent; number of spores per sporangium unknown.

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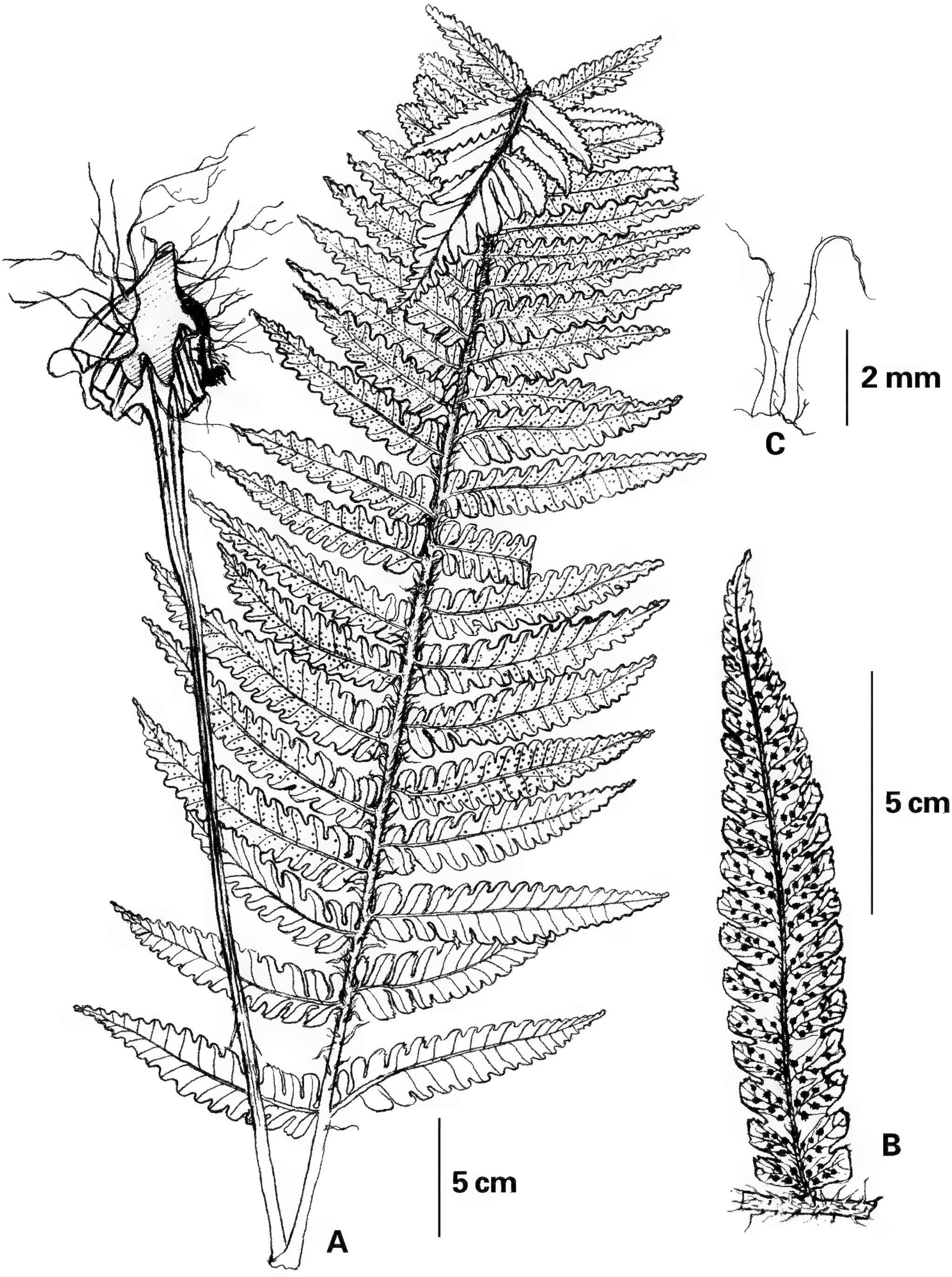

Figure 1. *Dryopteris jiucaipingensis* P. S. Wang, Q. Luo & Li Bing Zhang. —A. Habit. —B. Portion of rachis showing pinna at mid-portion of leaf blade. —C. Rachis scales. Drawings taken from the paratype *Q. Luo 1024* (BJ).

Distribution and habitat. *Dryopteris jiucaipingensis* is known only from the type locality in Luobu Stone Forest Sinkhole, Zhushi Yi Autonomous Xiang, Hezhang County, in northwestern Guizhou. The unique habitat at high altitude and in moist, low-light conditions at the karst sinkhole suggests that *D. jiucaipingensis* is endemic to this sinkhole. *Dryopteris jiucaipingensis* was noted in acidic soil near a large rock inside the sinkhole, at an elevation of 2580 m.

IUCN Red List category. Only one population of *Dryopteris jiucaipingensis* with ca. 100 individuals was found. The new species should clearly be classified as CR or Critically Endangered, according to the International Union for Conservation of Nature and Natural Resources guidelines (IUCN, 2008). The Luobu Stone Forest Sinkhole is not particularly known as a tourist attraction, but occasional visitors in summer could easily cause damage to the fragile habitats inside the sinkhole.

Etymology. The epithet of the new species is taken from the Chinese pinyin "jiucaiping," for the name of the highest peak in Guizhou Province.

Discussion. Based on the 1-pinnate leaf lamina, symmetric pinna bases, unbranched lateral veins on lobes, and the pinnae that are lobed shallowly or lobed to only half their depth, *Dryopteris jiucaipingensis* is clearly a member of *Dryopteris* sect. *Hirtipedes* Fraser-Jenk. Fraser-Jenkins (1986) listed 17 species in *Dryopteris* sect. *Hirtipedes* worldwide, 14 of which occur in China. Wu and Lu (2000) later recognized 19 species for their *Flora of China.* Iwatsuki (1995) recognized a few additional species for *Flora of Japan. Dryopteris jiucaipingensis* differs from any of these species as known so far. In terms of the dissection of the pinnae and the number of pinna pairs per leaf lamina, *D. jiucaipingensis* appears to be similar to *D. lunanensis*. However, *D. jiucaipingensis* has leaf blades of 63–68 × 24–27 cm and light brown rachis scales, while *D. lunanensis* has leaf blades of ca. 48 × 30 cm and nearly black rachis scales (Wu & Lu, 2000). Also, *D. jiucaipingensis* grows at much higher elevation (ca. 2580 m) than *D. lunanensis* (below 900 m; Wu & Lu, 2000). *Dryopteris jiucaipingensis* is also similar to *D. conjugata* Ching with its light brown rachis scales and pinnae that are usually shallowly lobed to halfway lobed, but sometimes completely lobed, but the former has 20 to 25 pairs of pinnae per leaf lamina, while the latter has 30 to 40 pairs of pinnae per leaf lamina.

In addition to *Dryopteris conjugata*, *D. jiucaipingensis*, and *D. lunanensis*, there are four species in *Dryopteris* sect. *Hirtipedes* in China with pinnae usually shallowly lobed to halfway lobed, and sometimes pinnatipartite at the pinna base, with unbranched lateral veins on the lobes: *D. hangchowensis* Ching, *D. microlepis* (Baker) Ching, *D. paralunanensis* W. M. Chu ex S. G. Lu, and *D. thibetica* (Franch.) C. Chr. *Dryopteris hangchowensis* occurs in Zhejiang Province in eastern China and Japan, *D. microlepis* is known from Guizhou and Yunnan provinces, *D. paralunanensis* is known from only Yunnan, and *D. thibetica* has been collected from Gansu, Sichuan, and Yunnan, although not from Tibet (Wu & Lu, 2000). These seven species can be distinguished from one another by the following key.

KEY TO *DRYOPTERIS LUNANENSIS* AND ALLIES IN CHINA AND JAPAN

1a. Lower fertile pinnae with 1 or 2 rows of sori on each side of pinna rachis ..... *D. hangchowensis*
1b. Lower fertile pinnae with multiple rows of sori on each side of pinna rachis.
  2a. Pinna lobes broadly deltate, separated by obtuse angles; sori arranged in a V-pattern on each pinna ..... *D. thibetica*
  2b. Pinna lobes oblong, separated by acute angles; sori 2 to 6 rows along pinna rachis.
    3a. Rachis scales nearly black; leaf blades ca. 48 × 30 cm ..... *D. lunanensis*
    3b. Rachis scales light brown to dark brown.
      4a. Petiole and rachis scales narrowly subulate or hairlike; leaf blades 25–50 × 10–20 cm ..... *D. microlepis*
      4b. Petiole and rachis scales usually lanceolate to linear.
        5a. Pinnae in ca. 17 pairs, falcate-lanceolate; leaf blades ca. 30 × 16 cm ..... *D. paralunanensis*
        5b. Pinnae in 20 to 40 pairs, narrowly elliptic; leaf blades larger than 60 × 24 cm.
          6a. Pinnae to 25 pairs; pinna lobes to 15(to 20) pairs ..... *D. jiucaipingensis*
          6b. Pinnae 30 to 40 pairs; pinna lobes to 25 pairs ..... *D. conjugata*

Paratypes. CHINA. **Guizhou:** Hezhang Co., Zhushi Yi Autonomous Xiang, Luobu Stone Forest Sinkhole, 2580 m, 10 June 2011, *Q. Luo 1024* (BJ, MO).

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Polystichum tiankengicola (Dryopteridaceae), a New Species from a Karst Sinkhole from Guizhou, China

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ABSTRACT. A new pteridophyte species, *Polystichum tiankengicola* Li Bing Zhang, Q. Luo & P. S. Wang (Dryopteridaceae), is described and illustrated from a high-elevational karst sinkhole from Guizhou Province in China. Morphological evidence suggests that *P. tiankengicola* is a member of series *Basigemmifera* W. M. Chu & Z. R. He in section *Micropolystichum* Daigobo, based on the presence of bulbils on rachis and the small habit. *Polystichum tiankengicola* is unique in series *Basigemmifera* in having a bulbil at both the base and apex of the rachis. Morphologically, the new species is most similar to *P. capillipes* (Baker) Diels, also of series *Basigemmifera*, but beyond the distinctive number of bulbils on the rachis, *P. tiankengicola* has a truncate lamina apex and its perispores have an echinate sculpture with irregular ridges, in contrast to *P. capillipes*, which has only one bulbil at the base of the rachis, an acuminate lamina apex, and perispores that have a granular sculpture. *Polystichum tiankengicola* is found only from the highest elevational, karst sinkhole known in China (2530 m) and is considered to be Critically Endangered (CR), based on IUCN Red List criteria.

Key words: Alpine flora, China, Dryopteridaceae, Guizhou, IUCN Red List, karst sinkhole, *Polystichum*.

The Jiucaiping, or the Leek Terrace, ca. 26°51′6.516″N, 104°41′34.26″E, was so named because of the common occurrence of *Allium wallichii* Kunth (Amaryllidaceae) toward the summit of the mountain. The site is located at the junction of Hezhang, Shuicheng, and Weining counties in northwestern Guizhou. As the highest peak in Guizhou Province, China, with an elevation of 2906 m, Jiucaiping is richly diverse in its fern flora. In recent years, a number of new fern species have been discovered from Jiucaiping and neighboring regions, including *Cystopteris guizhouensis* X. Y. Wang & P. S. Wang (Wang & Wang, 1997a), *Dryopteris hezhangensis* P. S. Wang (Wang & Wang, 2001), *Polystichum jiucaipingense* P. S. Wang & Q. Luo (Luo, 2009), *P. nayongense* P. S. Wang & X. Y. Wang (Wang & Wang, 1997b), and *P. puteicola* Li Bing Zhang, H. He & Q. Luo (Zhang et al., 2010). Recently, Wang and Wang (1991, 1994, 1997b, 2001) further documented quite a number of fern species new to Guizhou from this area, e.g., *Aleuritopteris veitchii* (Christ) Ching, *Athyrium biserrulatum* Christ, *A. filix-femina* (L.) Roth, *Cystopteris moupinensis* Franch., *Dryopteris nyingchiensis* Ching, *D. thibetica* (Franch.) C. Chr., *Gymnopteris delavayi* (Baker) Underw., *Lepisorus papakensis* (Masam.) Ching & Y. X. Ling, *Leptolepidium dalhousiae* (Hook.) K. H. Shing & S. K. Wu, *Polystichum brachypterum* (Kunze) Ching, *P. cyclolobum* C. Chr., and *P. tsus-simense* (Hook.) J. Sm. var. *mayebarae* (Tagawa) Sa. Kurata. In 2008, field exploration of Jiucaiping revealed a new species of *Polystichum* Roth found at the highest elevational, karst sinkhole in China (2530 m, in the Luobu Stone Forest), which might be the highest such sinkhole documented in the world. The new species is unique in the genus with its proliferous bulbil at both the base and apex of the rachis and is described herein.

Polystichum tiankengicola Li Bing Zhang, Q. Luo & P. S. Wang, sp. nov. TYPE: China. Guizhou: Hezhang Co., Zhushi Yi Autonomous Xiang, Luobu Stone Forest Sinkhole, 26°49′17.76″N, 104°44′8.19′′E, among crevices, 2530 m, 12 Mar. 2009, *Q. Luo 08380* (holotype, CDBI; isotypes, BJ, MO, Herbarium Pei-Shan Wang [Guizhou Institute of Biology]). Figures 1, 2.

Haec species *Polysticho capillipedi* (Baker) Diels affinis, sed rhachidi bulbilis duobus (vs. bulbilo unico in *P. capillipedi*) instructa, lamina apice truncata (vs. acuminata) atque perisporarum sculptura echinata irregulariter cristata (vs. granulata) differt.

Plants perennial, summer-green, caespitose, 7–22 cm tall; rhizome ca. 1 cm, ascending; sparsely or densely covered with scales; scales linear, brown, ca. 0.1 mm; roots dark brown when dry, to 12 cm, ca. 0.3 mm diam. Leaves 5 to 10 per rhizome; petiole 3–9 cm, 0.3–0.9 mm diam. at mid-portion, adaxially canaliculate, green; basal petiole scales lanceolate, 1.2–3.5 × 0.1–0.8 mm, chartaceous or membranous, composed of multiple cell layers, brown, margin minutely ciliate (microhairs not evident in Fig. 1D), apex long-caudate, matte; distal petiole scales lanceolate, 1.0–2.8 × 0.1–0.3 mm, differing in size, composed of 1 or 2 cell layers, membranous, brown, margin long-ciliate, apex long-caudate, matte. Leaf lamina lanceolate, slightly contracted toward base, 1-pinnate, 8–14 × 1.6–2.4 cm wide at mid-portion, at widest portion 1.8–2.7 cm near the lamina base, apex truncate; rachis 0.2–0.5 mm diam. at mid-portion, adaxially sulcate, with two proliferous bulbils, one each at both the base and apex of the rachis, sometimes only one bulbil at either base or apex, rarely without bulbils; scales of rachis similar to distal petiole scales but smaller, variable in size, chartaceous, brown, margin minutely ciliate (microhairs not evident in Fig. 1E), apex caudate, matte; pinnae in 13 to 22 pairs, not overlapping, slightly pointing upward, basal 2 pairs 0.5–1.2 cm apart, alternate but nearly opposite at leaf base, deltoid in lower portion of leaf blade, oblong in upper portion of leaf blade, middle pinnae 0.9–1.2 × 0.5–0.7 cm, largest pinnae in lower half of blade, shortly petiolulate, chartaceous, asymmetrical at base, bi-pinnatifid; lobes in 2 or 3 pairs per pinna, alternate, elliptic or oblong, apex acute, basalmost pairs of lobes free or almost free, scaly abaxially and adaxially; microscales on abaxial surface subulate without dilated base (narrow-type microscales), 0.9–2.25 mm, base ca. 0.1 mm wide, with a few curly cilia on the basal margin; venation pinnate; midrib slightly raised abaxially, flat adaxially. Sori terminal on veinlets, the entire abaxial leaf blade fertile, 2 to 5 sori per pinna, close to midrib, center of sorus 1.2–1.6 mm distant from pinna margin; indusia peltate, 1–1.2(–1.5) mm diam., membranous, brown, erose on margin.

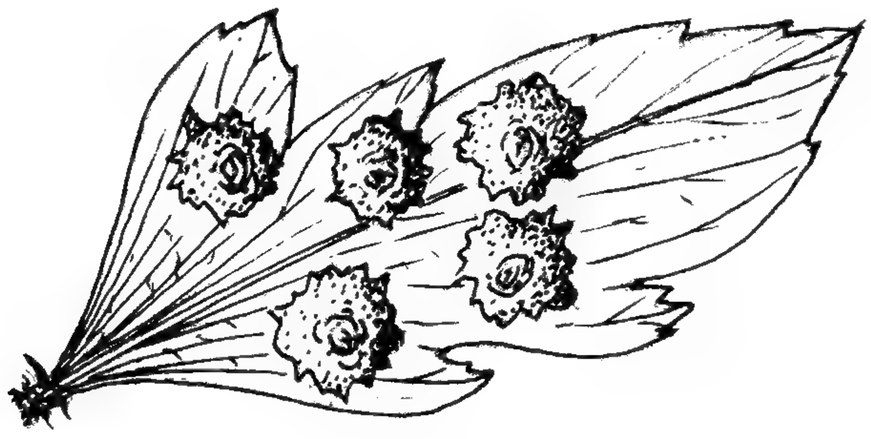
Spore morphology. The spores of *Polystichum tiankengicola* are round in a polar view and elliptic in an equatorial view, with a spore size ca. 46.3 × 63.5 μm (polar axis × equatorial axis). The ratio of the length of the polar axis to that of the equatorial axis is ca. 0.73:1. The perispore sculpture is echinate with irregular ridges (Fig. 2E).

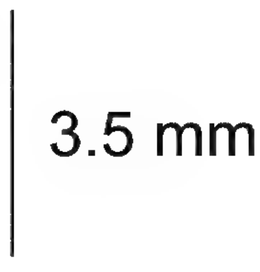
Distribution and ecology. *Polystichum tiankengicola* is known only from the type locality in the Luobu Stone Forest Sinkhole, in Hezhang County, northwestern Guizhou. Its unique habitat, being found at a sinkhole at high altitude (2530–2580 m) and in moist and low-light conditions in an area of karst topography, suggests that *P. tiankengicola* is likely endemic to this sinkhole. *Polystichum tiankengicola* grows in basic soil among limestone rubble or on limestone cliffs at the cave entrance at the bottom of a sinkhole, ca. 30 m below the ground surface. The type population extends from the bottom of the sinkhole to the cave entrance, an area of approximately 600 m². Associated ferns include *P. neolobatum* Nakai and *P. thomsonii* (Hook. f.) Bedd.

IUCN Red List category. Only one population with ca. 150 individuals was found at the type locality. *Polystichum tiankengicola* should clearly be classified as CR or Critically Endangered, according to the International Union for Conservation of Nature and Natural Resources guidelines (IUCN, 2008). Although the Luobu Stone Forest Sinkhole is not particularly a tourist attraction and is relatively inaccessible to typical visitors, the more adventurous do occasionally visit the bottom of the sinkhole in summer when precipitation is high, causing damage to the fragile habitats inside the sinkhole.

Etymology. The epithet of the new species is taken from the Chinese pinyin for "tiankeng," meaning "sinkhole," and the Latin suffix "–cola," meaning "dweller," referring to the species being a sinkhole dweller.

Discussion. *Polystichum tiankengicola*, with its small plants only to 22 cm tall and the proliferous bulbils on the rachis, is clearly a member of series *Basigemmifera* W. M. Chu & Z. R. He, currently within section *Micropolystichum* Daigobo. However, *P. tiankengicola* is unique in series *Basigemmifera* in having two bulbils, with one each found at the base and apex of the rachis. Morphologically, *P. tiankengicola* is most similar to *P. capillipes* in its small habit, another member of series *Basigemmifera*. Notably, *P. capillipes* has only one bulbil at the base of the rachis and it occurs in western China, including western Hubei and the Himalaya. The two species are potentially sympatric in northwestern Guizhou. In addition to the difference between the two species in the number of bulbils on the rachis,





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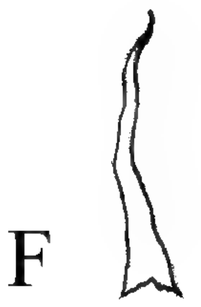

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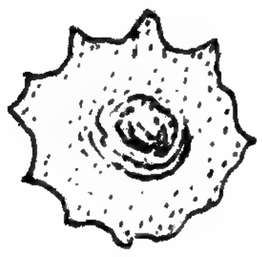

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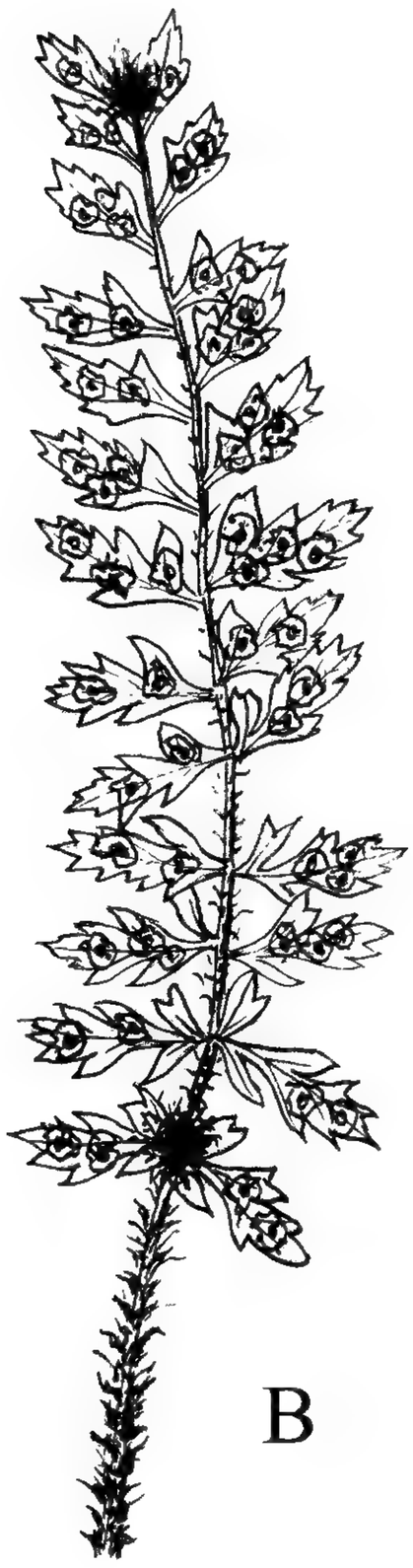

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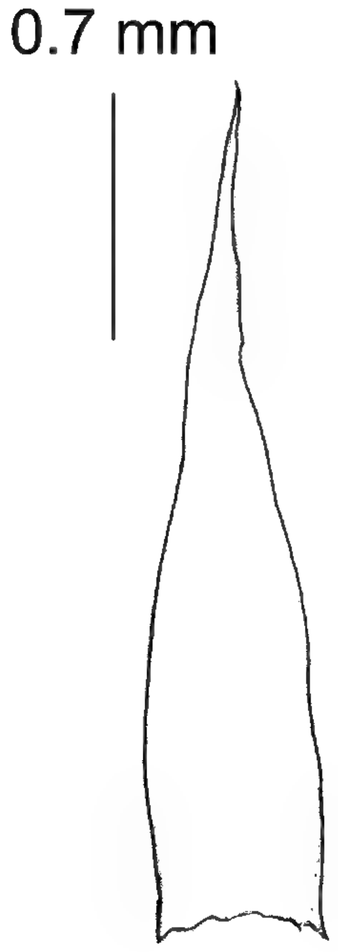

D

Figure 1. *Polystichum tiankengicola* Li Bing Zhang, Q. Luo & P. S. Wang. —A. Fertile plant habit. —B. Leaf, with bulbils evident at apex and base of lamina. —C. Pinna, abaxial surface. —D. Scale from base of petiole. —E. Rachis scale. —F. Microscale. —G. Indusium. A–G taken from the isotype *Q. Luo 08380* (MO).

the leaves of *P. tiankengicola* have a truncate lamina apex, the pinna lobes are acute apically, and the pinnae are deltoid in shape in the lower portion of the leaf blade, but oblong above. The leaves of *P. capillipes* have an acuminate lamina apex, the pinna lobes are acuminate apically, and the pinnae are oblong in the lower portion of the leaf blade. Palynologically, the perispores of *P. tiankengicola*

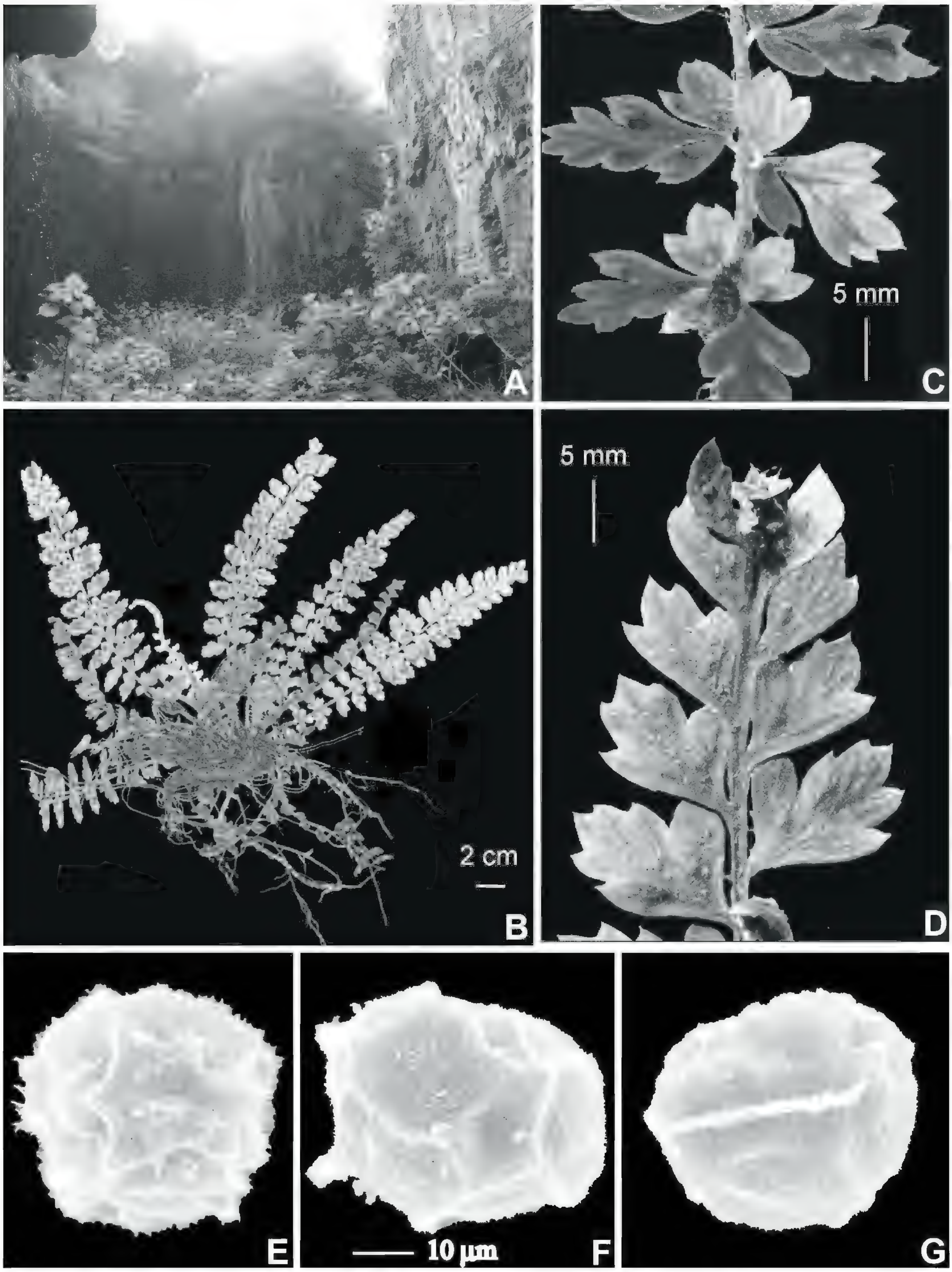

Figure 2. *Polystichum tiankengicola* Li Bing Zhang, Q. Luo & P. S. Wang. —A. The sinkhole and type locality for the new species *P. tiankengicola*. —B. Plant habit. —C. Lower portion of lamina, showing the basal bulbil on the rachis. —D. Upper portion of lamina, showing the apical bulbil on the rachis. —E. SEM micrograph of the spore of *P. tiankengicola* in polar view, taken from the paratype *Q. Luo 08353* (BJ). —F, G. SEM micrographs of the spores of *P. capillipes* (Baker) Diels in equatorial view. F is taken from *Qinghai-Xizang Expedition 11519* (PE) from Yanbian Co., Sichuan, China; G is taken from *Y.-T. Zhang & K.-Y. Lang 624* (PE) from Zhamo (Bomi) Co., Xizang (Tibet), China.

have an echinate sculpture, with numerous irregular ridges (Fig. 2E), while those of *P. capillipes* have a granulate sculpture (Fig. 2F, G), with only a few ridges. Notably, the perispore sculptures of *P. capillipes* were based on two samples from Sichuan and Tibet in China, respectively, and are consistent (Fig. 2F, G) with each other, but both differ from a previous report by Xiang (1992) in which *P. capillipes* was reported with a reticulate perispore sculpture. This implies that the currently circumscribed *P. capillipes* could be polyphyletic.

Only two species of *Polystichum* are known to consistently have two proliferous bulbils on the leaf rachis, *P. bigemmatum* Ching ex L. L. Xiang and *P. tiankengicola*. The former taxon has bipinnate leaves and both bulbils are located at the apex of the rachis (Kung et al., 2001), while the new species has pinnate leaves and the two bulbils are located at the base and apex, respectively, of the rachis. *Polystichum biggematum* is a member of section *Macropolystichum* Daigobo, following Kung et al. (2001), based on its bipinnate leaves and the presence of bulbils apically on the rachis.

The discovery of *Polystichum tiankengicola* in Jiucaiping is further evidence that this high-elevational sinkhole location is abundantly rich in fern diversity. The alpine vegetation, the variety of soils related to extraordinary limestone substrates, and the rarely disturbed habitats in Jiucaiping and neighboring regions certainly contribute to the evolution and preservation of this rich fern diversity.

Paratypes. China. **Guizhou:** Hezhang Co., Zhushi Yi Autonomous Xiang, Luobu Stone Forest Sinkhole, 2530–2560 m, 10 Oct. 2008, *Q. Luo 08326a* (BJ, HGAS, Herbarium Pei-Shan Wang [Guizhou Institute of Biology]), 2580 m, 10 Oct. 2008, *Q. Luo 08353* (BJ, MO, Herbarium Pei-Shan Wang [Guizhou Institute of Biology]).

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Woodsia guizhouensis (Woodsiaceae), a New Species from a Limestone Area in Guizhou, China

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ABSTRACT. A new pteridophyte species, *Woodsia guizhouensis* P. S. Wang, Q. Luo & Li Bing Zhang (Woodsiaceae), is described and illustrated from higher elevational areas in Guizhou, China. It is morphologically most similar to *W. andersonii* (Bedd.) Christ and *W. rosthorniana* Diels. *Woodsia guizhouensis* is only 3–8 cm tall, its rhizome scales are light brown with sparsely fimbriate margins, its pinnae are short-petiolulate, and its pinna bases are cordate or sometimes rounded. The perispore sculpture of *W. guizhouensis* pollen is cristate, with numerous acanthoid projections and a few irregular perforations. *Woodsia guizhouensis* is only known from four localities in western Guizhou and is considered to be Endangered (EN), based on IUCN Red List criteria.

Key words: China, Guizhou, IUCN Red List, *Woodsia*, Woodsiaceae.

The fern genus *Woodsia* R. Br. is one of ca. 15 genera recognized by Smith et al. (2006) in the family Woodsiaceae s.l., although recent molecular study has supported the recognition of a monotypic Woodsiaceae s. str. (Schuettpelz & Pryer, 2008). *Woodsia* s. str. (excluding *Cheilanthopsis* Hieron. and *Protowoodsia* Ching) contains more than 30 species, occurring in Asia, Europe, and North America. There are 21 species in China, 19 of which were documented in the Chinese-language *Flora of China* (Wu, 1999) and two from earlier works, with *W. kangdingensis* H. S. Kung, Li Bing Zhang & X. S. Guo from Sichuan (Kung et al., 1995) and *W. okamotoi* Tagawa from Taiwan (Tagawa, 1938; DeVol, 1994).

In the last three years, four independent field trips were made (August 2007, 2009; September 2008, 2009) to southwestern Guizhou Province in China. During each of these trips, an unknown species of *Woodsia* was collected from western Guizhou. Field observations, morphological work, and palynological studies confirm that the taxon validated herein is an undescribed species, thus representing the 22nd species of *Woodsia* reported for China.

Woodsia guizhouensis P. S. Wang, Q. Luo & Li Bing Zhang, sp. nov. TYPE: China. Guizhou: Bijie City, Yangjiawang, Gonglongping Forestry Center, among crevices on wet limestone cliff, 27°12.92′N, 104°59.52′E, 1670 m, 21 Sep. 2008, *Q. Luo 08301* (holotype, CDBI; isotypes, BJ, MO). Figures 1, 2.

Species *Woodsiae rosthornianae* Diels affinis, a qua statura minore 3–8 cm alta, paleis rhizomatis dilute brunneis margine sparsim fimbriatis atque pinnis lateralibus petiolulatis basi saepe leviter cordatis vel interdum rotundatis differt.

Plants perennial, deciduous, caespitose, 3–8 cm tall; rhizome short, erect, with a cluster of persistent petiole bases; sparsely scaled; rhizome scales light brown, membranous, ca. 2.5 × 0.1–0.6 mm, linear to lanceolate, sparsely fimbriate; adventitious roots dark brown when dry, to 12 cm, ca. 0.3 mm diam. Leaves deciduous, 5 to 10 per rhizome; grayish green when dried; petioles straw-colored, not articulate, 0.5–2.2 cm, 0.4–0.6 mm diam., adaxially canaliculate and green; basal petiole scales narrowly lanceolate, 1.2–4 × 0.1–0.8 mm, membranous, multicellular, light brown, fimbriate, matte; distal petiole scales narrowly lanceolate, 1.2–3.5 × 0.1–0.7 mm, membranous, multicellular, light brown, sparsely fimbriate, matte; leaf lamina narrowly elliptic, slightly contracted toward lamina base, 1-pinnate, 2–6 × 0.8–2 cm, apex obtuse; rachis 0.2–0.5 mm diam. at mid-point, adaxially sulcate, with no proliferous bulbils; rachis

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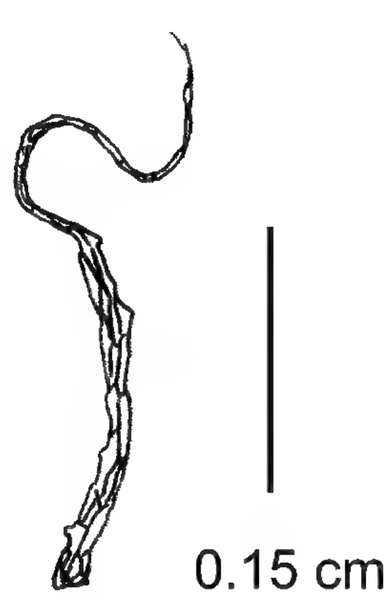

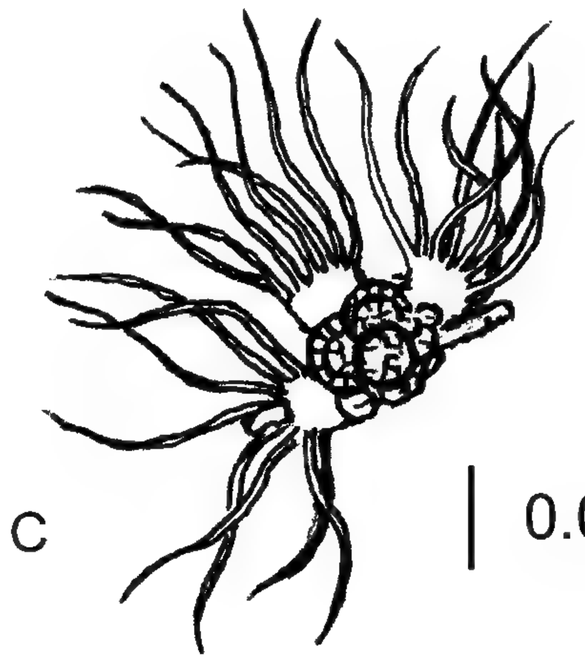

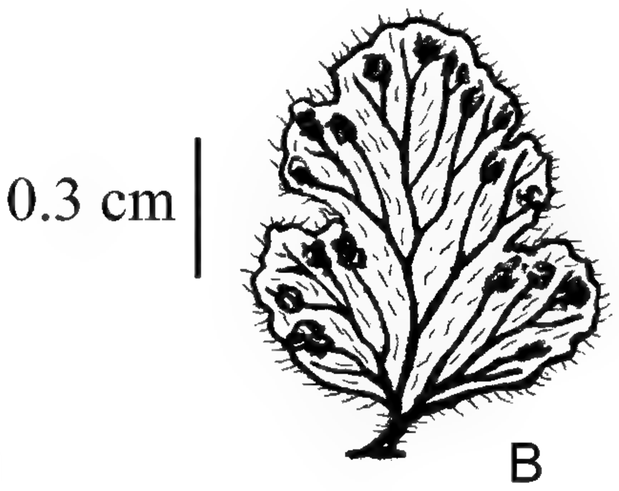

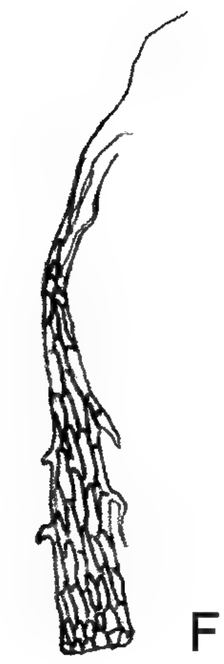

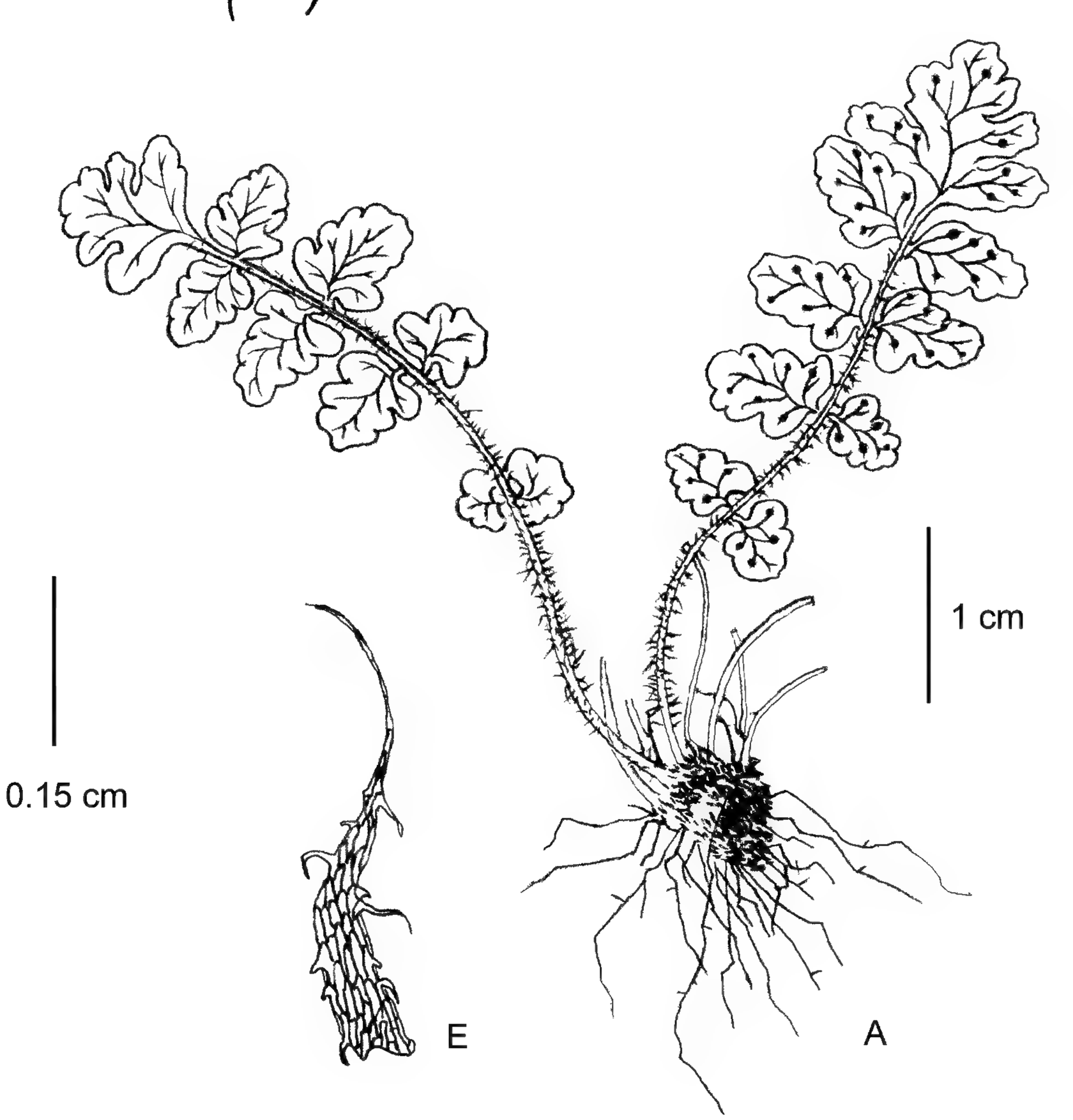

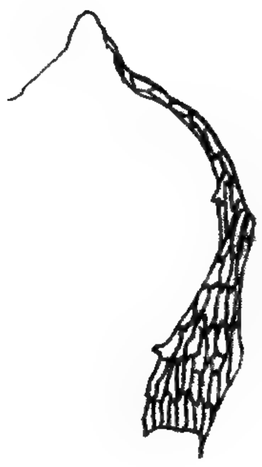

Figure 1. *Woodsia guizhouensis* P. S. Wang, Q. Luo & Li Bing Zhang. —A. Habit. —B. Pinna. —C. Sporangia surrounded by indusial lobes fimbriate at apices. —D. Scale from rhizome. —E. Scale from petiole base. —F. Scale from middle of petiole. —G. Rachis scale. Drawn from the isotype *Q. Luo 08301* (MO).

scales similar to distal petiole scales; pinnae in 3 to 8 pairs, herbaceous, lower pinnae ovate, 4–8 × ca. 3–6 mm, briefly petiolulate to 1 mm, base often shallowly cordate or sometimes rounded, apex obtuse or rounded; middle pinnae longer than lower pinnae but otherwise similar, ovate to oblong, 4–10 × 3–7 mm; terminal pinnae nearly an equilateral triangle, 0.8–1.2 cm, apex obtuse or rounded, with 3 pairs of lobes; lobes of pinnae 3 to 4 pairs, obtusely deltoid, nearly entire to crenate on margins; both surfaces of pinnae densely pubescent, trichomes yellowish clear, 0.53–0.69 mm × 14–22 μm; lamina with veins free, in 4 to 5 pairs from midrib. Sori round, dorsal or subterminal on veinlets, 1 to 4 per pinna segment; indusia shallowly cupulate, inferior, contracted to a jar-like shape when dry, 1–1.2 mm diam., membranous, brown, often 3-lobed, apices of lobes with multicellular trichomes 1.2–1.36 mm × 11–15 μm. Sporangia dehiscing into 4 to 5 portions when mature, each portion ca. 0.45 mm; annuli with 18 to 20

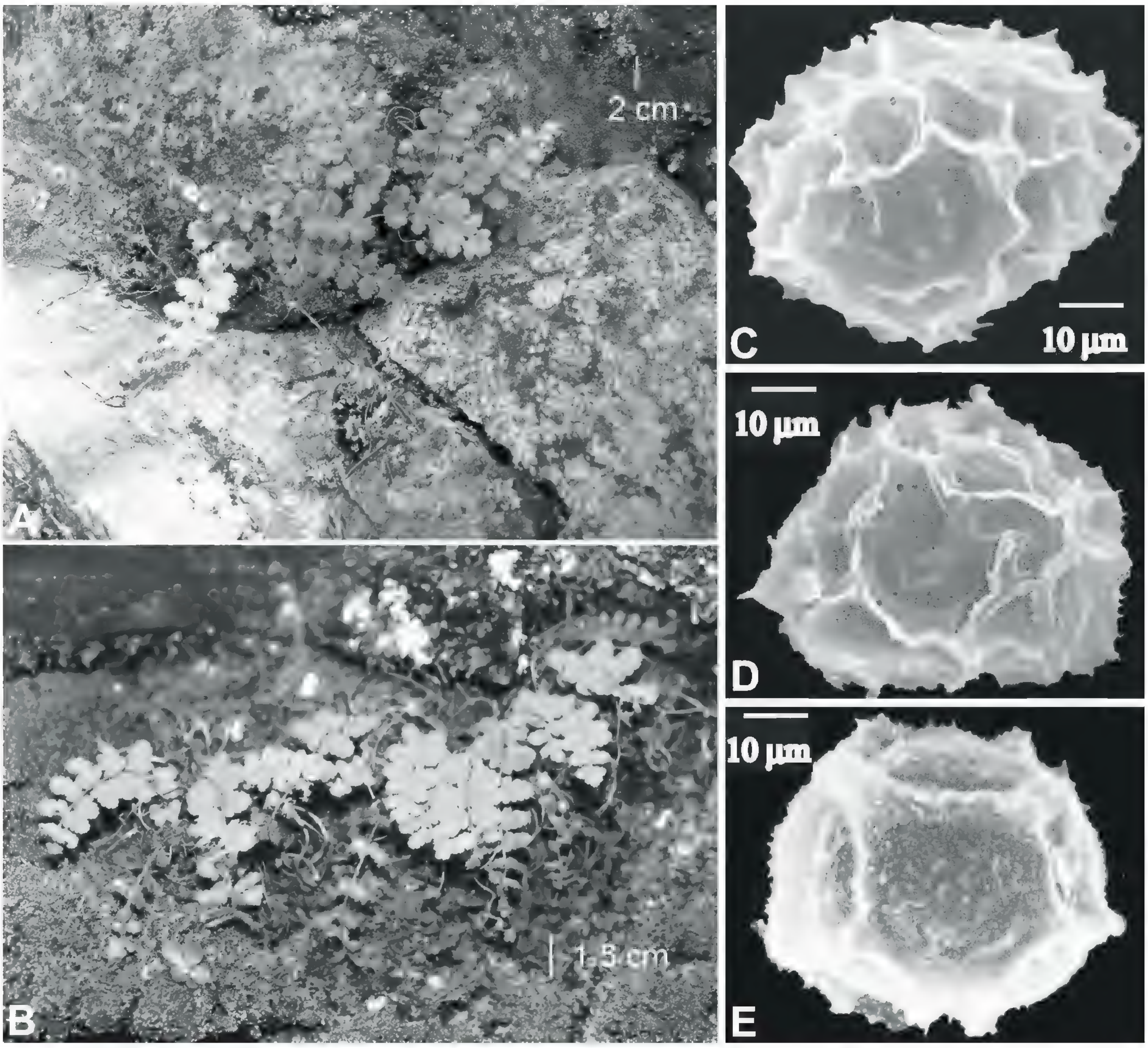

Figure 2. *Woodsia guizhouensis* P. S. Wang, Q. Luo & Li Bing Zhang. —A. Plant habit at the type locality outside Bijie City, northwestern Guizhou. —B. Plant habit in Pu'an County, western Guizhou. —C. Polar view of spore of *W. guizhouensis* under SEM. —D. Equatorial view of spore of *W. guizhouensis* under SEM. Both C and D taken from the isotype *Q. Luo 08301* (MO). —E. Polar view of spore of *W. rosthorniana* under SEM taken from *F.-K. Zhao 20562* (PE).

thickened cells; spores oblong, light brown, with cristate perispore sculpturing.

Spore morphology. Spores of *Woodsia guizhouensis* are bilateral, elliptic in polar view, and semi-orbicular in equatorial view. The spore size is ca. 40(37–44) × 57(47–67) µm (polar × equatorial axes). The ratio of the lengths of polar and equatorial axes is ca. 0.7:1. The perispore sculpturing is cristate, with numerous bent acanthoid projections and a few irregular perforations (Fig. 2C, D). Such cristate perispore ornamentation is common among Chinese species of *Woodsia* (Dai & Wang, 2007).

Distribution, habitat, and ecology. *Woodsia guizhouensis* was found in two nearby cities and one county in western Guizhou, from the environs of Bijie City and Liupanshui City, as well as Pu'an County. It is possible that this species also occurs in adjacent areas in western and northwestern Guizhou, famous for its mountainous habitats. This species may possibly be found in adjacent northeastern Yunnan. *Woodsia guizhouensis* grows in wet and shady limestone crevices or cliffs under broad-leaved forests. It has been seen in four different localities; three of these are more than 90 km apart from each other. Populations of *W. guizhouensis* are distributed in elevations from 1650 to 2300 m.

IUCN Red List category. Only four populations of *Woodsia guizhouensis* were observed, among locales in two different cities and one county, with a combined estimate of ca. 30 individuals noted among all populations seen. The new species should be

classified as Endangered or EN, according to IUCN (2008) Red List criteria. Although the habitat of *W. guizhouensis* in Liupanshui City for one paratype collection lies inside Yushe National Park and thus is well protected, detailed investigation for the population size and biology of the species is needed to best assess its vulnerability. The three remaining habitats in Bijie City, Liupanshui City, and Pu'an County, respectively, are not protected, which raises concerns about the conservation status of *W. guizhouensis*.

Etymology. The epithet of *Woodsia guizhouensis* is taken from the Chinese pinyin word "guizhou," for the name of the province in southwestern China, and from the Latin suffix "–ensis," meaning "of origin or place."

Discussion. The new species *Woodsia guizhouensis* is morphologically most similar to *W. rosthorniana* Diels, but *W. guizhouensis* is smaller, only 3–8 cm tall; its rhizome scales are light brown with sparsely fimbriate margins; its pinnae are short-petiolulate, to 1 mm; and its pinna bases are cordate or sometimes rounded. In contrast, *W. rosthorniana* is larger, 7–25 cm tall; its rhizome scales are brown with entire margins; its pinnae are sessile; and its pinna bases are obtuse or rounded (Wu, 1999). *Woodsia rosthorniana* can be found in scattered locations to the west and north in Chongqing, Gansu, Hebei, Liaoning, Shaanxi, and Sichuan, and to the southwest in Yunnan Province, but the taxon has not been collected in Guizhou (Ching & Wu, 1983; Wu, 1999).

Palynologically, the spores of *Woodsia guizhouensis* and *W. rosthorniana* differ. The perispore sculpture of *W. guizhouensis* is cristate, with numerous acanthoid projections and a few irregular perforations (Fig. 2C, D), while that of *W. rosthorniana* is granulate, with only a few cristae and numerous spinules (Fig. 2E; see also Dai & Wang, 2007). The equatorial axis of spores in *W. guizhouensis* is 57 μm on average, whereas in *W. rosthorniana* it is shorter, ca. 49 μm. *Woodsia guizhouensis* is also similar to *W. andersonii* (Bedd.) Christ, but the new species has briefly petiolulate pinnae (to 1 mm; Fig. 1A, B) and larger spores (ca. 40 × 57 μm), while *W. andersonii* has sessile pinnae, although it is similar to *W. guizhouensis* in its ovate shape (Wu, 1999) and smaller spores (ca. 35 × 47 μm; Dai & Wang, 2007). *Woodsia andersonii* is distributed in Gansu, Shaanxi, Sichuan, Tibet, and Yunnan in addition to the type locality, Sikkim (Wu, 1999). *Woodsia guizhouensis* is further similar to *W. okamotoi* Tagawa from Taiwan (Tagawa, 1938; DeVol, 1994) in its small leaf size. However, *W. okamotoi* has a darker (castaneous) rachis and petiole (vs. stramineous or straw-colored in *W. guizhouensis*). Its abaxial leaf surfaces have more densely distributed scales. *Woodsia okamotoi* occurs at much higher elevations (2800–3700 m), while *W. guizhouensis* was collected at elevations of 1650–2300 m.

Woodsia guizhouensis is the second species in the genus noted in Guizhou. The other is *W. polystichoides* D. C. Eaton (Wang & Wang, 2001), the most widespread species of *Woodsia* in China, which is distributed throughout northern, southwestern, central, and eastern locales, with the exception of Fujian. *Woodsia polystichoides* is also reported from Taiwan as well as Korea, Japan, and the Russian Far East (Wu, 1999). The occurrence of *W. polystichoides* in Guizhou was only recently discovered (Wang, 1992) from northeastern to northwestern mountainous terrains (Wang & Wang, 2001). Both *W. guizhouensis* and *W. polystichoides* have rhizome scales with fimbriate margins, a character state that distinguishes them from *W. rosthorniana* (see above). In comparison with *W. polystichoides*, *W. guizhouensis* is a smaller fern, only 3–8 cm tall, its rhizome scales are light brown, its petioles are not articulate, and it has three to eight pairs of ovate to oblong pinnae, while *W. polystichoides* is 10–30 cm tall, its rhizome scales are darker and brown, its petioles are articulate above the base, and it has 16 to 30 pairs of lanceolate pinnae (Wu, 1999). The perispore sculpture of *W. polystichoides* is also cristate (alate in Dai & Wang, 2007), but only with approximately four straight cristae on each spore as opposed to numerous bent cristae in *W. guizhouensis* (Fig. 2C, D).

Key to Morphologically Similar and/or Sympatric Species of *Woodsia guizhouensis* in China

1a. Petioles articulate above the base ... *W. polystichoides*
1b. Petioles not articulate above the base 2
2a. Pinnae petiolulate to 1 mm ..... *W. guizhouensis*
2b. Pinnae sessile 3
3a. Petiole and rachis of leaf frond castaneous or brown ..... *W. okamotoi*
3b. Petiole and rachis of leaf frond stramineous or straw-colored 4
4a. Pinnae ovate, pinnatifid, not or only slightly contracted toward lamina base; trichomes under sori separate ..... *W. andersonii*
4b. Pinnae elliptic, pinnatipartite, contracted toward lamina base; trichomes under sori fused at bases ..... *W. rosthorniana*

Paratypes. CHINA. **Guizhou:** Liupanshui City, Yushe National Park, 1700 m, 14 Aug. 2009, *J.-H. Zhao & N.-W. Zhao 508* (GZTM); Liupanshui City, from Shuicheng to Yushe, 1910 m, 19 Sep. 2009, *N.-W. Zhao s.n.* (Herbarium Pei-Shan Wang [Guizhou Institute of Biology]); Pu'an, betw. Digua Town & Erdaoqiao, 25°68.83′N, 104°95.99′E, 1650 m, 9 Aug. 2007, *L. Zhang & H. He 316* (CTC, MO).

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Taxonomic Revision of the *Casearia ulmifolia* Complex (Salicaceae)

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Abstract. Field studies and examination of herbarium specimens have led to a taxonomic revision of the *Casearia ulmifolia* Vahl ex Vent. complex (Salicaceae). A new species circumscription is presented for *C. ulmifolia*, *C. cotticensis* Uittien is reestablished, and one new species, *C. murceana* R. Marquete & Mansano, is described from Pará, Brazil. Morphological descriptions, a taxonomic key, geographical distributions, diagnostic characteristics of the species, and illustrations are provided.

Key words: Brazil, *Casearia*, Flacourtiaceae, IUCN Red List, Pará, Salicaceae, South America.

Casearia Jacq. (Salicaceae, which now includes the non-cyanogenic Flacourtiaceae, Chase et al., 2002; Angiosperm Phylogeny Group, 2009) is a pantropical genus that includes ca. 180 species occurring in many different vegetation types ranging from dense ombrophilous forests, seasonal semideciduous forests, savannas, and coastal vegetation. Sleumer (1980) cited 80 species of *Casearia* in the Neotropics and subdivided this genus into six sections, with *Casearia* sect. *Casearia* further considered as six informal groups. *Casearia ulmifolia* Vahl ex Vent. belongs to the Arboreae group of the *Casearia* sect. *Casearia*, which comprises 10 species.

While reviewing *Casearia* species in Brazil for taxonomic study (Marquete, unpublished), we noted that Sleumer (1980) broadly circumscribed *C. ulmifolia*, synonymizing 10 names in recognition of this species. This resulted in a taxon with broad morphological variation. *Casearia ulmifolia*, for instance, has flowers with oblong anthers, an undeveloped connective with apical glands slightly barbate to glabrous, longitudinal anther dehiscence with lateral dehiscent zones, and stigmas with dispersed hirsute trichomes. In contrast, the flowers of *C. cotticensis* Uittien present deltoid anthers, a developed connective with glabrous or subglabrous apical glands, transverse anther dehiscence with dehiscent zones oriented downward, and stigmas that are tomentose. Despite these distinctions, Sleumer (1980) considered these taxa conspecific.

The complex *Casearia ulmifolia* studied here is characterized by its stipule shape (subulate or linear-lanceolate) and indument (villous or tomentose), leaf blade with acuminate to cuspidate apex, oblong or deltoid anthers, barbate, glabrous or tomentose apical gland, elongated, ovate ovary, and slightly sulcate or fimbriate seed testa.

Species of the *Casearia ulmifolia* complex occur in the Amazon region bordered by the states of Mato Grosso to the south and the states of Roraima and Amapá to the north. This distribution reaches the Atlantic coast of southeastern Brazil, since the complex extends from Maranhão and Piauí southward to Bahia, Espírito Santo, and Minas Gerais. These species also occur in other South American countries such as Colombia, Guyana, Peru, Surinam, Trinidad, and Venezuela. These plants were noted to grow at altitudes from 50 to 950 m. The species of this complex occur in dense ombrophilous forests and its variations, according to Veloso et al. (1991).

Despite the fact that *Casearia cotticensis* and *C. ulmifolia* are distributed in close localities, they are morphologically distinct. They differ by leaf texture, trichomes, venation, and especially anther dehiscence. *Casearia murceana* R. Marquete & Mansano, found in Pará State in eastern Amazonia, is more similar to *C. ulmifolia*, differing by the inflorescence structure, absence of glands, and flower indument.

Sleumer (1954, 1980), who studied the Malaysian (eight species) and Neotropical species of Flacourtiaceae, respectively, and Breteler (2008), in his work for *Casearia* from Africa, mentioned that the flowers of the genus do not offer characters to distinguish the species. We verified that floral characters in the

Brazilian species are very helpful for identifying species of *Casearia*.

Materials and Methods

The present survey is based on collections deposited in the following herbaria: BHCB, C, CEN, CESJ, F, G, Sergio Tavares, Universidade Federal Rural de Pernambuco, Recife, Pernambuco, HUEFS, IAN, INPA, K, L, MG, MO, NY, P, R, RB, RBR, TEPB, U, UB, and UEC. Our collected material was deposited in RB, and additional duplicates were sent to international herbaria (B, F, L, MO, NY, P, USMS). Expeditions were conducted in the following regions of Brazil: Amazonia and central and southeastern Brazil, where the species were not located, but the habitat was observed.

The morphological terminology follows Hickey and King (2000), Font Quer (1979), and Stern (1992). The geographical distribution maps of the species were drawn using the geographic information system (GIS), each specimen having its locality georeferenced. The vegetation formations used here follow the *Classification System of the Brazilian Vegetation* by Veloso et al. (1991), adapted to a universal system, and the map of Brazilian vegetation (IBGE, 2004).

1. Casearia cotticensis Uittien, Recueil Trav. Bot. Néerl. 22: 369, fig. 9. 1926. TYPE: Suriname. Cottica River, 21 June 1921, *L. Gonggrijp BW. 5332* (holotype, U [barcode] 0002179 not seen, U photo; isotypes, K [barcode] 000471158 not seen, K photo, RB). Figure 1.

Casearia reginae J. F. Macbr. Publ. Field Mus. Nat. Hist., Bot. Ser. 15: 356. 1936, nom. inval. TYPE: Peru. Loreto: La Victoria, *L. Williams 2758* (holotype, F-612974 not seen, F neg. 059654 of F-612974; isotypes, G, US not seen).

Tree or small tree (6–)10–18(–27) m tall × (12–)20 cm DBH; trunk with smooth bark, ca. 1 mm thick, brown-orange, not fibrous; sapwood cream-colored, slightly oxidizing; branches terete, without thorns, glabrous, glabrescent at base and sparsely villous at apex in some specimens; branches black at apex, brown at base; lenticels rhombic to elliptical. Stipules 10 × 0.5–1 mm, linear to lanceolate, caducous, tomentose on both faces, encountered more frequently on the apex of young branches, eglandular. Leaves persistent, variable in size and shape; blades (6.5–)7–12.5(–17.5) × (2–)2.5–4.5(–8) cm, asymmetrically lanceolate, narrowly elliptical, oblong-lanceolate, coriaceous (chartaceous to membranaceous when young), opaque on both faces, glabrescent on both faces to tomentose on primary and secondary veins (abaxially tomentose when young), apex caudate to short caudate with sharp tip, base slightly attenuate, widely attenuate to asymmetrical, margins serrate to serrulate with glands on the serrations; translucent dots, densely dispersed on blade (difficult to see with the naked eye on some leaves); (4)5 to 7(to 10) pairs of widely ascendant secondary veins, venation lax and more prominent on abaxial face, primary vein prominent on adaxial face; petiole (3–)4–7 mm, slender semi-terete, glabrous, thin. Inflorescences fasciculate, multiflowered, 15 to 20+, densely tomentose, subsessile; peduncule (0.5–)2–5 mm long, sparsely tomentose, slightly flattened; bracts 1–1.5 × 0.5–0.9 mm, oval (conchiform), chartaceous, externally tomentose; bracteoles 3–4 × 0.5–0.9 mm, widely subulate, membranaceous, yellowish, with elongated glands, tomentose externally; pedicels (1–)1.5–2(–4) mm, flattened, articulated, with 0.5–1 mm from branch insertion to articulation, tomentose. Flower buds 2.2 × 1.5 mm, obovate to globose, white tomentose, greenish; sepals 5, (2–)3–4 × (1–)1.5–2 mm, oval to oval-oblong, fused at disk base with lobes and filaments, with glands inside the lobes, perigynous, greenish, outer 3 with tomentose trichomes and inner 2 externally tomentose only from the central portion of the base almost to the apex, internally glabrous with glands, whitish on both faces; stamens with filaments (0.5–)1–2 mm, flattened, free, sparsely tomentose near base and anther, fused at disk base; anthers deltoid, pubescent, with transverse dehiscence, diminutive, rounded and oriented downward, connective expanded, apical prominent gland inside, glabrous or subglabrous; disk lobes ca. 0.5 mm long, clavate, flattened at apex, tomentose, whitish, fused at base and alternating with filaments; ovary ovate, glabrous; style ca. 0.7 mm, thick, glabrous to sparsely tomentose in some cases, yellowish; stigma with base dilated and thinning at apex, slightly ovoid, tomentose, whitish. Fruit 7 × 3.5 mm, ovoid while immature, glabrous, reddish-green; seeds 2 to 5 per fruit, 2 × 1.5 mm, oblong; testa foveolate, aril fimbriate, yellowish, partially covering the seed; embryo straight, ca. 0.5 mm long, yellow, fleshy, surface smooth; cotyledon leaves rounded, hypocotyl radicle axis cylindrical.

Distribution and habitat. *Casearia cotticensis* is found in the dense ombrophilous forests of Brazil. It has been collected from Guyana, Colombia, Peru, and Suriname.

Phenology. *Casearia cotticensis* flowers from January to June and occasionally in September and October, and fruits in March and April.

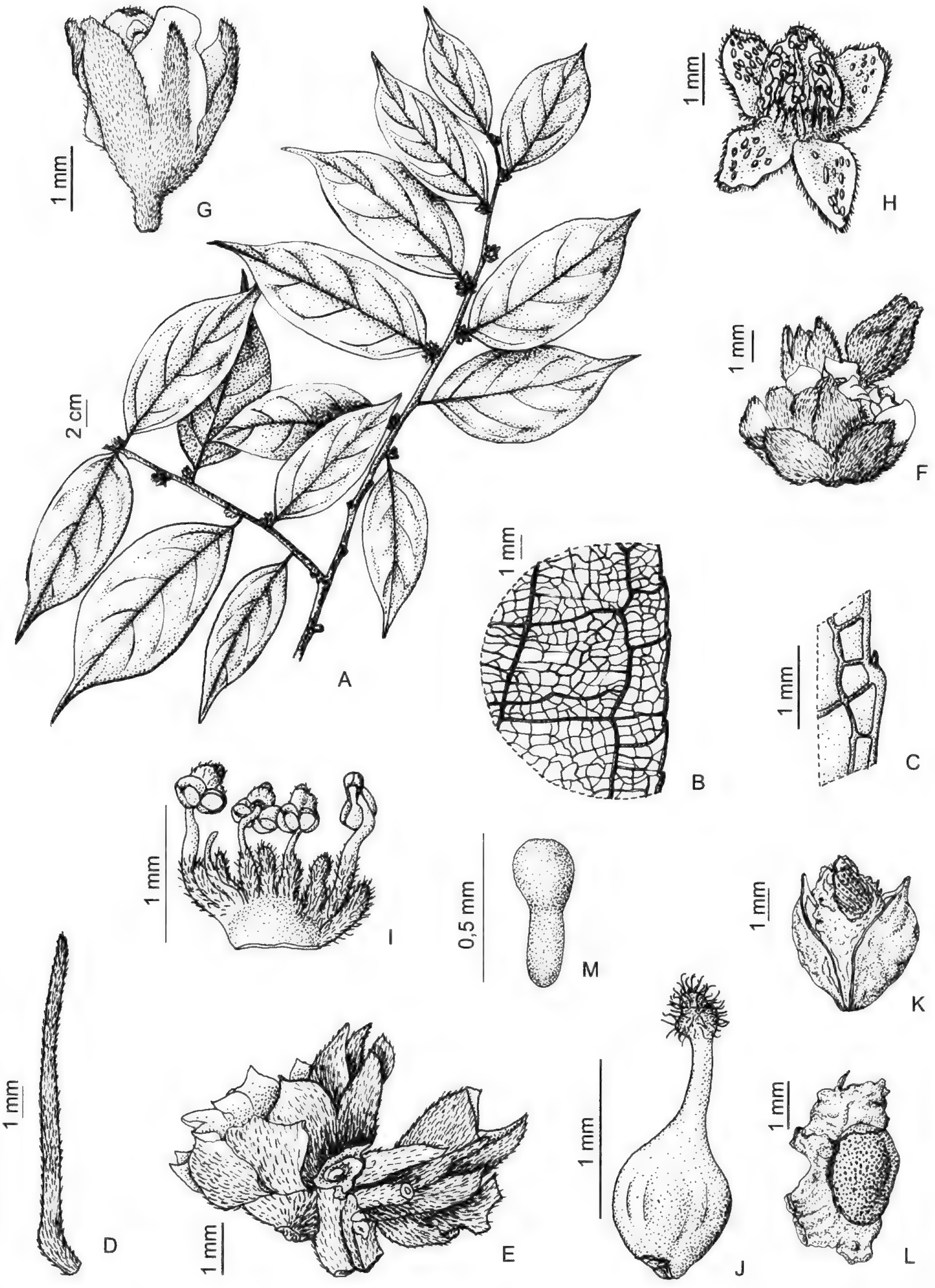

Figure 1. *Casearia cotticensis* Uittien. —A. Branch with inflorescences presenting buds and flowers. —B. Detail of leaf veins. —C. Detail of bristle with gland. —D. Stipule. —E. Peduncle with bracts and bracteoles. —F. Bracts and bracteoles surrounding the flowers. —G. Flower. —H. Flower with glands on sepal lobes. —I. Detail of stamens with anthers turned downward and filaments intercalated with the disk lobes. —J. Gynoecium with pilose stigma. —K. Fruit with seed and aril. —L. Seed with foveolate testa and fleshy aril. —M. Linear embryo. A, E, F, J from *C. A. Sothers & C. F. da Silva 446* (INPA); B–D from *A. Ducke s.n.* (RB 21430); G from *M. G. Silva & A. Pinheiro 4268* (RB); H, I from *A. Ducke s.n.* (RB 21430); K–M from *C. A. Cid Ferreira 8718* (INPA).

Discussion. Analyses of the RB isotype of *Casearia cotticensis*, and the name *C. reginae* (Macbride, 1936), which was previously synonymized with *C. ulmifolia* by Sleumer (1980), led us to conclude that both names refer to a species that is distinct from *C. ulmifolia*. The characters that differentiate *C. cotticensis* from *C. ulmifolia* are the coriaceous leaves (when mature), the blades glabrescent to tomentose on both faces on the primary and secondary veins, the primary vein adaxially prominent, anthers deltoid with an expanded connective and glabrous apical gland, with transverse dehiscence turned downward, and a tomentose stigma.

Representative specimens examined. BRAZIL. **Acre:** Brasiléia, Reserva Extrativista Chico Mendes, seringal Porongaba, 22 Feb. 1992, *L. de Lima & R. Saraiva 328* (INPA, MO). **Amazonas:** Manaus, Estr. Manaus, Porto Velho, BR 319, Km. 265, 15 Apr. 1976, *O. P. Monteiro & J. Ramos 711* (INPA); Km. 540, 23 Apr. 1976, *O. P. Monteiro & J. Ramos 901* (INPA); Estr. Manaus, Caracaraí, Reserva Biol. do INPA, 1978, *A. Anderson s.n.* (INPA-142413); Estr. ZF 3, Km. 24, coletado ao lado da Reserva 1202, 17 June 1980, *J. Lima & B. Zimmerman 518* (INPA); Distr. Agropec., 90 km NNE de Manaus, Res. 1501 (Km. 41), 14 Apr. 1992, *A. A. Oliveira et al. 421* (INPA); Manaus, Itacoatiara, Km. 26, Reserva Florestal Ducke, 9 May 1995, *C. A. Sothers & C. F. da Silva 446* (INPA, MO-04928928, RB); Maués, igarapé Albino, afluente do rio urupadí, 16 Sep. 1983, *J. Lima 553* (INPA). **Maranhão:** Santa Luzia, Faz. Agripec, Varig, caminho para o rio Mutum, margem do rio Pindaré, 5 Apr. 1983, *M. F. F. Silva et al. 1011* (IAN, MO-5952103, NY-897357). **Mato Grosso:** Aripuanã, Km. 238 da BR 174, núcleo Juína, 16 Jan. 1979, *M. G. Silva & A. Pinheiro 4268* (IAN, NY-897352, RB). **Pará:** Rio Tapajóz, 2 June 1923, *A. Ducke s.n.* (RB 21430); Almeirim, Mt. Dourado, bloco Bananal, estr. secund. entre áreas 15 e 43, 15 May 1986, *M. J. Pires & N. T. Silva 1043* (INPA); Altamira, rio Xingu, Res. Indíg. dos Assurinis, 27 Jan. 1987, *S. A. M. Souza et al. 856* (MG); Belém, bosque mun., 30 Jan. 1948, *N. T. da Silva 83* (IAN); Oriximiná, estr, Oriximiná–Óbidos, ca. 55 km de Oriximiná, 5 June 1980, *C. Davidson & G. Martinelli 10068* (INPA, MO-5952098); rio Cachorro, margem direita, pique do dique, 26 Aug. 1986, *C. A. Cid Ferreira 8056* (MG, MO, RBR); Santarém, Ipanema, 13 May 1927, *A. Ducke s.n.* (RB-21445); Alter do Chão. Área 65, 2°5′36″N, −54°9′25″W, 19 Mar. 2000, *J. C. da Costa s.n.* (INPA-212106); Área 69, 27 Apr. 2000 (fl.), *J. C. Costa s.n.* (INPA-212121). **Rondônia:** Ariquemes, 15 km de Ariquemes, BR 364, 13 Mar. 1987, *M. Nee 34359* (INPA, MO-5767906); Costa Marques, 10 km ao N da cidade de Costa Marques, 29 Mar. 1987, *C. A. Cid Ferreira 8718* (INPA, MO-04793140); Jiparaná, glebag-Km. 15, 7 Apr. 1983, *H. F. P. Filho & M. G. Silva s.n.* (INPA-116228); Porto Velho, Terr. Guaporé, 1952, *E. Cordeiro & J. F. da Silva 219* (RB); entrada da estr. Bom-Sossego, 27 Jan. 1983, *L. Carreira et al. 293* (IAN, MG). COLOMBIA. **Antioquia:** Valley of Rio Anorí, betw. Dos Bocas & Anorí, 1 Oct. 1984, *J. L. Zarucchi 3340* (MO-3511359, NY-375893, RB). GUYANA. Mazaruni Station, 8 May 1933, *T. G. Tutin 67* (RB); Matthew's Ridge, clearing at intersection WX-7 & ridge lines, 31 Jan. 1955, *R. S. Cowan 39374* (MO-2142368, RB). PERU. **Loreto:** Rio Napo, near Entrada de Isla Inayuga, 20 Sep. 1972, *T. B. Croat 20533* (MO-2280655, RB).

2. Casearia murceana R. Marquete & Mansano, sp. nov. TYPE: Brazil. Pará: Santarém, 5 Mar. 1923, *A. Ducke s.n.* (holotype, RB-21427). Figure 2.

Species nova *Casseariae ulmifoliae* Vahl ex Vent. affinis, sed ab ea inflorescentis sessilibus, sepalis plerumque absque glandulis in lobis, filamentis villosis, antheris in glandulas apicales barbatas desinentibus atque ovario basi glabro inter medium et apicem dense villoso differt.

Trees, trunk with smooth to slightly wrinkled bark, brown; branches terete, without thorns, slender; trichomes yellowish, pilose, densely and/or sparsely tomentose, without lenticels. Stipules 2.5–5.5 × 0.6–1 mm, linear to narrowly lanceolate, oblong-elongate to subulate, caducous, villous or pilose on external face, with sparse trichomes on the internal face, more frequent at the apex of young branches, with glabrous apical gland, caducous; leaves persistent, dark, opaque on both faces, variable in size; blades (5.5–) 6.5–9(–19) × (3.5–)4.7–8 cm, elliptical, widely elliptical, or rarely obovate and asymmetrical, chartaceous, dark when dry, pilose on both faces; trichomes concentrated on the adaxial face, especially on the primary and secondary veins, sparser on blade surfaces; abaxial face pilose across the entire blade, more so on veins, apex caudate, rarely cuspidate with sharp tip, base attenuate to obtuse; margins sparsely serrate to serrate with glands on the serrations, translucent areas or dots not visible on adult leaves; (4 to)6 to 9(10) pairs of secondary veins widely ascendent; reticulate venation lax, but prominent on abaxial face, reticulation not noticeable on either face; petiole (2–)3–7.5(–8) mm, subterete, sparsely pilose to pilose or densely tomentose, thin. Inflorescences fasciculate, sessile, pauciflorous, (4 to)8 to 9(to 11) or more flowers, densely villous; bracts and bracteoles ca. 1 mm, ovate, scarious, few, pilose to glabrescent; pedicels 2–4 mm, terete, thin, articulate near sepals, with 0.5 mm from branch insertion to articulation, pilose to tomentose, yellowish green. Flower buds 5–8 × 3 mm, oblong, villous, green; sepals (3.5–)4–7 × 1.5–2 mm, lanceolate, elliptical or ovate with apex subrounded to subobtuse, fused at base; glands generally present, greenish, pilose externally and sparse trichomes internally, calyx tube villous; stamens with filaments 2–2.5 mm, terete, free, villous, fused at disk base and sepals; anthers oblong, obovate, to ovate, glabrous, connective undeveloped, dehiscence longitudinal, with lateral openings; apical gland long-barbate; lobes of disk 1 mm long, clavate, slightly flattened at apex,

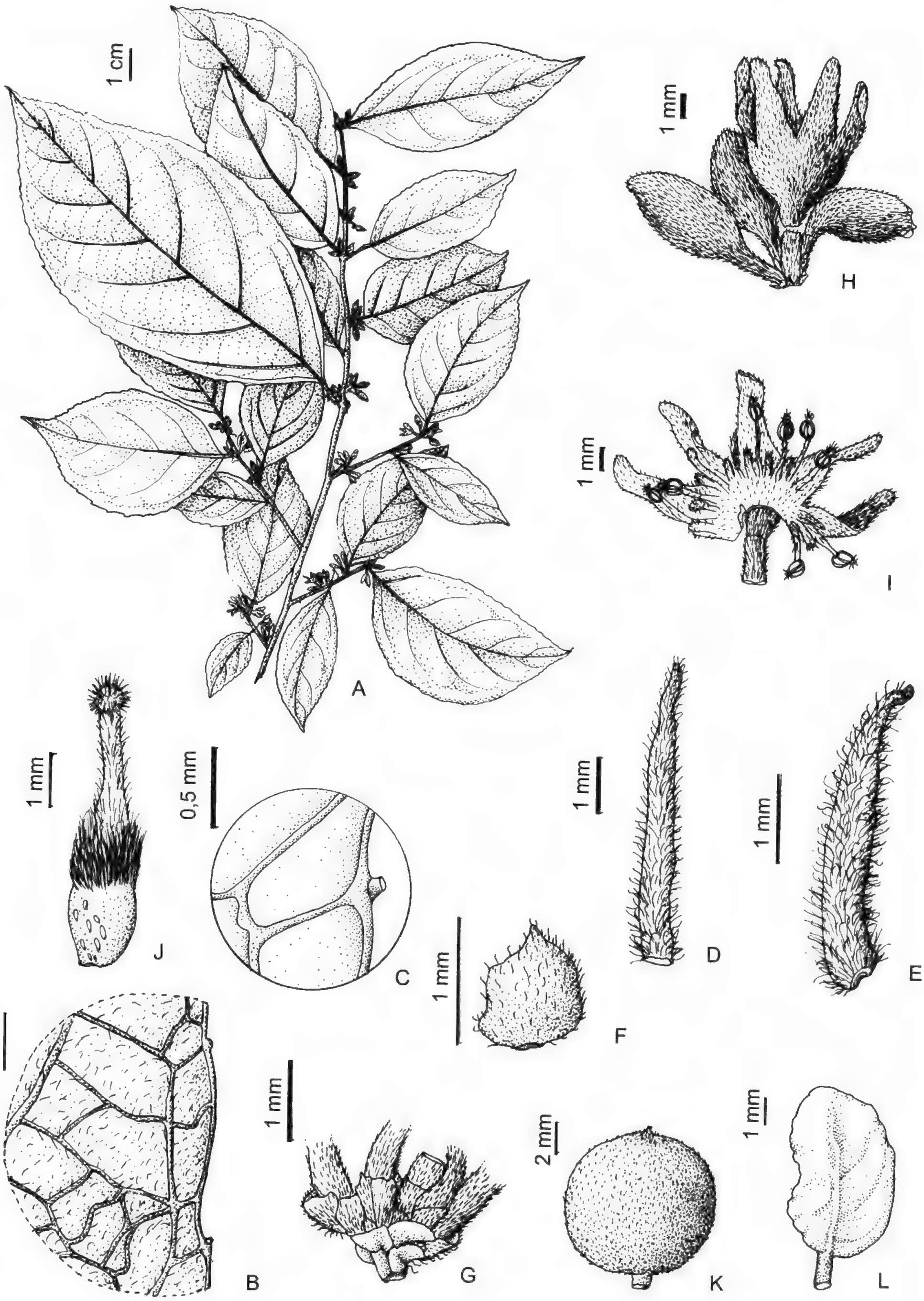

Figure 2. *Casearia murceana* Marquete & Mansano. —A. Branch with inflorescences presenting buds and flowers. —B. Detail of leaf blade and margin. —C. Detail of serration with gland. —D, E. Stipules. —F. Detail of bract. —G. Details of bracts and bracteoles at pedicel base. —H. Inflorescences with buds and flowers. —I. Detail of open flower. —J. Gynoecium with villous trichomes at apex. —K. Fruit. —L. Embryo. A–J from *A. Ducke s.n.* (RB-21427); K–L from *P. Cavalcante & M. Silva 1762* (MG).

villous, fused at base and alternating with filaments; ovary ovate-elongate with salient glands on its surface, glabrous at base, densely villous from median portion to style; style thick, villous up to its insertion in ovary, sparsely pilose at apex; stigma clavate, hirsute. Fruits 1.8–1.9 × 1.8–1.9 cm, rounded, dehiscent into 3 valves, green when immature, densely canescent; peduncle 4 mm, thickened, pilose; seeds 8 to 10 per fruit, 1.2 × 0.9 cm, angular, black; testa slightly sulcate, black, aril small, yellowish; endosperm fleshy, internally sulcate; embryo straight, 1.1 × 0.8 mm, with prominent vascular bundles; cotyledon leaves oblong with rounded apex, slightly cordate at base; hypocotyl radicle, terete, truncate at apex.

Distribution. *Casearia murceana* is known to occur in the dense ombrophilous forests of Brazil.

IUCN Red List category. *Casearia murceana* is known from no more than 10 localities in the Amazonian region. According to IUCN Red List Criteria (IUCN, 2001), the species is considered Vulnerable (VUB2a).

Phenology. *Casearia murceana* flowers from January to July and occasionally in December, with very few fruits from December to July.

Etymology. The specific epithet honors João Murça Pires (1917–1994), who was a great researcher of Amazonian flora.

Discussion. *Casearia murceana* differs from *Casearia ulmifolia* by its sessile inflorescences, the sepals generally without glands on lobes, the villous filaments, the anthers with a barbate apical gland, and an ovary glabrous at base and villous from the median portion to the style. *Casearia murceana* also differs from *C. tenuipilosa* Sleumer in that it has yellowish pilose to tomentose branches, the leaves varying from elliptical to widely so, to rarely obovate, leaf adaxial surface sparsely pilose, the pedicels articulate near the sepals, the sepals generally with glands, calyx tube internally villous, ovary with glands, and fruit densely canescent. However, *C. tenuipilosa* has brownish hirsute branches, lanceolate, oblong-lanceolate to narrow obovate leaves, with the adaxial surface glabrous, except the veins, medium articulate pedicels, the sepals without glands, an internally glabrous calyx tube, ovary without glands, and fruit minutely tomentose.

Paratypes. BRAZIL. **Acre:** Brasiléia, 5 Nov. 1980, *B. Nelson 852* (INPA, NY). **Amazonas:** Maués, Fomento Fed., 27 Oct. 1971, *M. F. Silva & L. Coelho 29* (INPA). **Mato Grosso:** Aripuanã, próximo a cachoeira, Centro Humboldt, 8 Oct. 1973, *G. T. Prance, C. C. Berg, F. A. Bisby, E. Lleras, W. C. Steward, J. F. Ramos, D. F. Coelho & J. F. Lima 18207* (INPA, MG, MO-2373530); Aripuanã, 5 Aug. 1976, *M. Gomes & S. Miranda 159* (INPA); Dardanelos, margem da estrada entre acampamento e porto, 3 Oct. 1975, *P. Lisboa, J. F. Ramos & G. A. Mota 615* (INPA, MO). **Pará:** Altamira, rd. Transamazonica, trecho Altamira Itaituba, Km. 24, 21 Aug. 1978, *R. P. Bahia 103* (MO-3496088, RB); Bragança, 24 Oct. 1926, *A. Ducke s.n.* (RB-21443); Marabá, estrada do Amapá, 28 Nov. 1970, *L. Coelho 71* (INPA); Parauapebas, Serra dos Carajás, CTI do parque botânico, 22 Aug. 1988, *J. A. Bastos 187* (MG); Santarém, 5 Mar. 1923, *A. Ducke s.n.* (RB-21427); Serra Diamantina, 14 Dec. 1966, *P. Cavalcante & M. Silva 1762* (MG); estr. Cuiabá–Santarém, BR 163, Km. 941, 13 Nov. 1977, *G. T. Prance with A. S. Silva, M. J. Balick, C. C. Berg, A. J. Henderson, B. W. Nelson, R. P. Bahia & M. R. dos Santos 25358* (MO-2662566, UEC); Alter do Chão, Sep. 1998, *W. E. Magnuson s.n.* (INPA-212042). **Rondônia:** Jarú, BR 364, Rod. Cuiabá–Porto Velho, Km. 423, linha 603, 2 July 1984, *C. A. Cid Ferreira 4989* (INPA, MO-5158840); Santa Barbara, arredores de Santa Barbara, 15 km E do Km. 117, 12 Aug. 1968, *G. T. Prance & J. F. Ramos 6868* (INPA).

3. Casearia ulmifolia Vahl ex Vent., Choix Pl. 46, 1808. *Guidonia ulmifolia* (Vahl ex Vent.) Baill., Traité Bot. Méd. Phan 2: 827. 1884. TYPE: Trinidad, 1778, *Ryan 20* (holotype, C, F-21325 neg. of C; isotypes, B-Willd., BM, BR, G-DC, G-Ventenant, P-JU). Figure 3.

Casearia celtidifolia Kunth, Nov. Gen. Sp. [H.B.K.] (quarto ed.) 5: 363. 1821. TYPE: Venezuela. Terr. Fed. Amazonas: "prope Angostura et Carichana, ad ripam fluminis Orinoco," *Humboldt & Bonpland 1047* (holotype, P not seen; isotypes, B†, F neg. 13663 of B).

Casearia petraea Benth., J. Bot. (Hooker) 4: 111. 1841. TYPE: Guyana. Pirara, "stony savannahs," *Schomburgk 718* (holotype, K [barcode] 000471157 not seen, K photo; isotypes, BM not seen, F neg. 61246 of BM, FI not seen, K [barcode] 000471156 not seen, K photo, L [barcode] 00010758 not seen, L photo, P, US, W).

Casearia blanchetiana Miq., Linnaea 22: 801. 1849. TYPE: Brazil. Bahia: "forets des marais" Olhos d'água, *J. S. Blanchet 3119* (holotype, U [barcode] 0002182 not seen, U photo; isotypes, B†, F neg. 13661 of B, BM, BR, F, FI, G, GH, K [barcode] 000471154 not seen, K [barcode] 000471154 photo, K [barcode] 000471155 not seen, K [barcode] 000471155 photo, L [barcode] 00010779 not seen, L photo, MO-1886703, NY-97933 not seen, NY photo, P, U [barcode] 0002181 not seen, U photo, W).

Casearia cambessedesii Eichler, Fl. Bras. (Martius) 13(1): 475. 1871. TYPE: Brazil. Minas Gerais: "sur les bords du Piracicaba a Itajuru," *St.-Hilaire B 1, nr. 608* (holotype, P; isotypes, F-935720 [P fragm.] not seen, F neg. 61271 of F-935720, L [barcode] 00010776 not seen, L photo).

Casearia celtidifolia Poepp. ex Eichler, Fl. Bras. (Martius) 13(1): 477, in obs. 1871, nom illeg. *Casearia tremifolia* J. F. Macbr., Candollea 8: 23. 1940, nom. nov. TYPE: Peru. Loreto: Maynas, *Poeppig 2263*

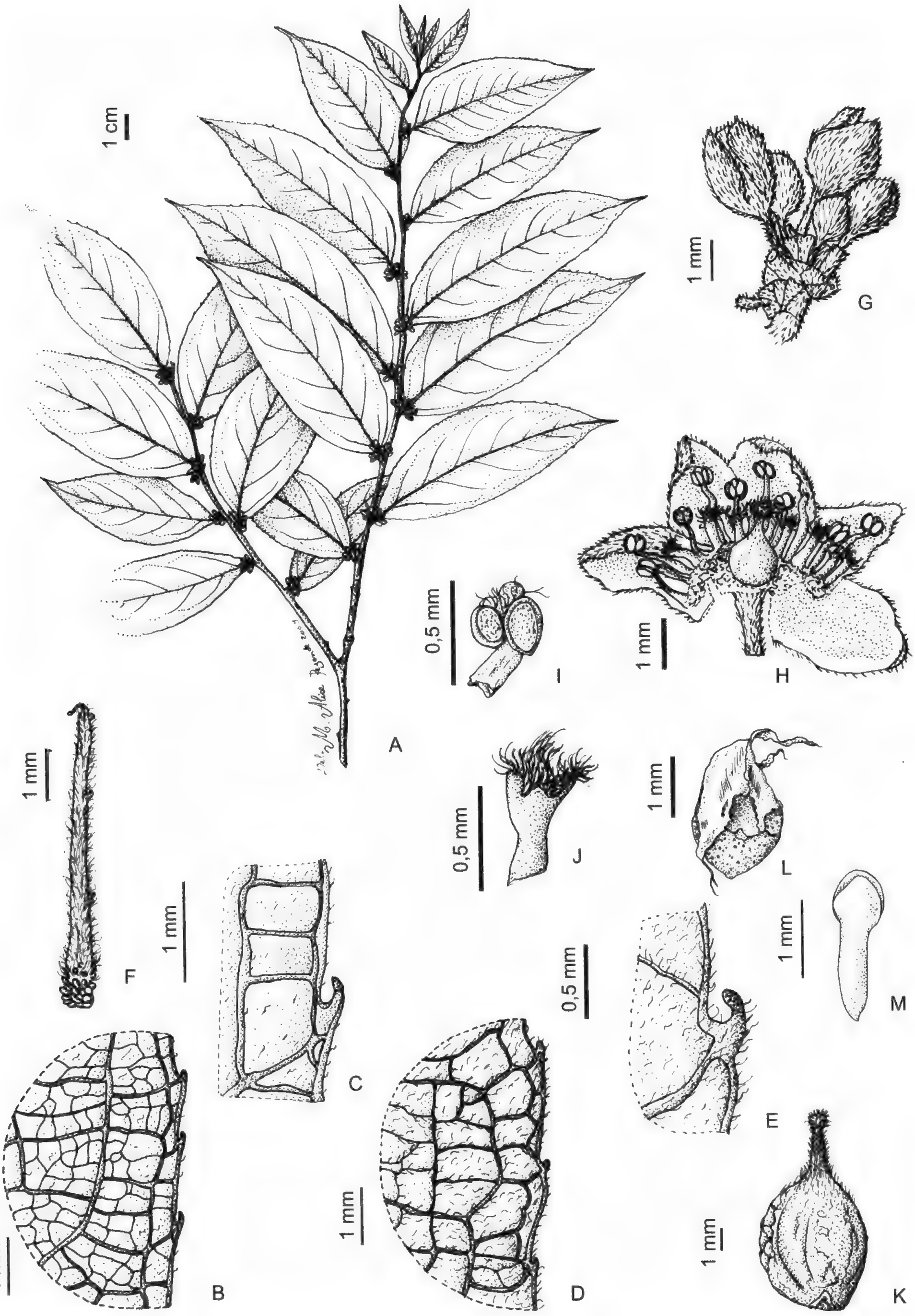

Figure 3. *Casearia ulmifolia* Vahl ex Vent. —A. Branch with inflorescences presenting buds and flowers. —B. Detail of leaf venation. —C. Detail of bristle with gland. —D. Detail of leaf venation with trichomes. —E. Detail of bristle with gland and sparse trichomes. —F. Stipule with glands at base. —G. Inflorescences with buds and flowers. —H. Detail of open flower. —I. Detail of anther.—J. Detail of disk lobe. —K. Gynoecium. —L. Seed with foveolate testa and fimbriate aril. —M. Spatulate embryo. A–C, I, J from *Ryan 20* (C); D–H from *A. Ducke s.n.* (RB-35686); K from *N. T. Silva & U. Brazão 60946* (IAN); L, M from *J. L. de Souza 343* (INPA).

(holotype, W; isotypes, B†, F. neg. 13665 of B, F-869334 [B fragm.] not seen, F neg. 61156 of F-869334, P [B fragm.] not seen, L [barcode] 00010777 [B fragm.] not seen, L photo).

Trees or shrubs up to 12(–26) m tall × 20+ cm DBH; trunk with smooth bark, brown; branches terete, without thorns, tomentose at apex of young branches, glabrescent at base, brown to black or greenish, with sparse lenticels. Stipules (5–)8–9 × (0.5–)1 mm, linear, lanceolate to subulate, caducous, tomentose on both faces, more frequent on apex of young branches, glands at base of interior face, glandular emergences at margins; leaves persistent, discolorous, opaque on both faces, variable in size; blade (5–)6.5–10.4(–12.2) × 2–4.3(–5.2) cm, oblong to lanceolate, membranaceous, lanceolate, trichomes tomentose on primary and secondary veins, sparser on blade surface, denser abaxially, translucent lines or dots dispersed through blade, apex acuminate, cuspidate to caudate, base short-attenuate, slightly asymmetrical, margins serrate, serrations glandular; 6 to 10(to 12) pairs of secondary ascendent veins, reticulation of veins and veinlets lax, more prominent on abaxial face; petiole (1–)1.5–4.5 mm, subterete, tomentose. Inflorescences fasciculate, ca. 20 to 30 flowers, pedunculate to short pedunculate, (2–)3–4 mm, tomentose; bracts and bracteoles 1–1.5 mm, ovate, hyaline, surrounding pedicel base, yellowish tomentose; pedicels 2–3 mm, terete, slightly flattened, articulate 0.5 mm from branch insertion to articulation apex, tomentose near sepals. Flower buds 1.5–2 × 1–1.5 mm, oblong to globose, tomentose, greenish; sepals 5, 2.5–3 × 1.5–2 mm, fused at base, ovate to oblong-ovate, externally tomentose, internally glabrous, glandular at apex, whitish on both faces (becoming more coriaceous at base, light brown, when dehydrated); stamens with filaments 1–1.5 mm, flattened, free, glabrous, fused at disk base; anthers oblong, connective undeveloped, dehiscence longitudinal, with lateral openings, rarely with few trichomes, on some thecae, with an apical, diminutive gland inside, glabrous to slightly barbate, brownish; disk lobes 0.5–0.6 mm long, 4-lobed apex, barbate to villous at apex, glabrescent and fused at base and alternating with filaments; ovary ovate, glabrous, tomentose or pubescent at style insertion; style short, glabrous or tomentose, glandular, stigma rounded to slightly capitate, hirsute. Fruit 6–7 × 3–4 mm, dehiscent into 3 valves, ovoid when immature, glabrous internally, tomentose externally near its insertion in style, to glabrous near base; sepals persistent; seeds 4 to 6, 2 × 1.5 mm, yellowish; aril thin, yellow, fimbriate, partially covering seed; testa foveolate, brown; endosperm fleshy, yellowish; embryo linear 1 × 0.5 mm, yellow without spots on surface; cotyledon leaves rounded; hypocotyl-radicle axis terete; embryo of fruit still young.

Distribution. *Casearia ulmifolia* is found in dense and open ombrophilous forests, semi-deciduous forest, savanna woodland, and wooded steppe-like savanna of Brazil. This species occurs in the Amazonian basin of Brazil and Venezuela, as well as in Trinidad, Guyana, and Peru.

Phenology. *Casearia ulmifolia* flowers from July to November and fruits from October to December.

Discussion. Our study agrees with some of the synonyms adopted by Sleumer (1980) for *Casearia ulmifolia*. However, comparisons of the type material of *C. cotticensis* (isotypes, K [barcode] 000471158, RB) and *C. reginae* (F neg. 50654 of the holotype) lead us to conclude that these species are synonyms but distinct from *C. ulmifolia*.

Based on the analyses of the isotypes of *Casearia tremifolia* (*Poeppig 2263*, F neg. 13665 of B†), *C. petraea* (*Schomburgk 718*, F neg. 61246 of BM), and *C. celtidifolia* (*Humboldt & Bonpland 1047*, F neg. 13663 of B), and the holotype of *C. ulmifolia* (*Ryan 20*, C), we verified that they should be kept in the synonymy of *C. ulmifolia*. The accepted synonyms have a similar leaf texture and shape, glands in the sepal inner face and apex, reduced and glabrous to slightly barbate anther apical glands, and an ovate ovary.

The holotype of *Casearia celtidifolia* deposited in the herbarium of Berlin was destroyed during World War II, but we were able to locate a photograph of it at F, under the epithet of *C. capitata* Kunth (*Humboldt & Bonpland 1047*, F neg. of B). The specimen was collected in Venezuela and the label has no collection date.

In our broadened circumscription, *Casearia ulmifolia* is characterized by the presence of pedunculate inflorescences, the sepals glandular at the apex, glabrous filaments, the anthers with glabrous to slightly barbate apical glands, and a glabrous ovary. Its great morphological plasticity led Sleumer (1980) to circumscribe it by uniting additional, distinct taxa, which has generated confusion in herbarium identifications.

In his treatment of the Neotropical *Casearia*, Sleumer mentioned the difficulty of distinguishing *C. arborea* (Rich.) Urb. from *C. ulmifolia* using sterile material. These taxa indeed share some similar characters, such as the leaf trichomes and shape, type of inflorescence, and gynoecium indument. However, the stipules of *C. arborea* are narrowly ovate, velutinous and eglandular on the margins,

while those of *C. ulmifolia* are lanceolate to subulate, densely tomentose on both faces, and have marginal glands at the base. These two species also differ by the leaf apex and texture, anthers and ovary shape, and seed testa ornamentation.

In terms of geographic distribution and habitat, *Casearia cotticensis* appears to be more concentrated in the Amazon region of South America, ranging from Guyana and Peru in the west to the state of Maranhão in northeastern Brazil. The taxon is found in dense ombrophilous forests, occasionally in open areas. It is noted from elevations between 50 and 600 m, but it is more common at lower altitudes, up to 200 m, usually in sandy clay soils. In contrast, to date, collections of *C. murceana* appear restricted to Brazil, documented from the states of Acre, Amazonas, Mato Grosso, Pará, and Rondônia, from lowland sites in dense ombrophilous forest. *Casearia murceana* is more frequent at altitudes around 100 m. As currently known, *C. ulmifolia* is the most broadly distributed species in this complex, since the taxon reaches Peru to the west.

In Brazil, *Casearia ulmifolia* can be found in dense and open ombrophilous forest, semideciduous forest, savanna woodland, wooded steppe-like savanna, with a varying altitude of 52–950 m, preferentially at altitudes between 100 and 300 m (Fig. 4).

Representative specimens examined. BRAZIL. **Acre:** Cruzeiro do Sul, Rio Juruá-Mirim, 19 May 1971, *P. J. M. Maas 13151* (INPA, MG, NY, R); Rio Branco, Parque Zoobotânico, 23 Jan. 1992, *G. Claros, Cytia & Leonildo 36* (INPA); Boa Vista, Rio Branco, 23 Aug. 1943, *A. Ducke 2071* (IAN, R). **Amapá:** Contagem entre Porot Platon e Serra do Navio, 10 Nov.–15 Dec. 1976, *N. A. Rosa 1162* (MG). **Amazonas:** margem do rio Cauaburí, entre rios Maturacá e Yá, 2 Feb. 1996, *N. T. Silva & U. Brazão 60946* (IAN); Lábrea, Rio Purus, Lago Preto, 20 June 1971, *G. T. Prance 13749* (INPA, MG, R); along the Rio Tarauacá, 21 June 1933, *B. A. Krukoff 4966* (SP); Manaus, colônia Santo Antônio, 3 Jan. 1969, *L. Coelho & Byron s.n.* (INPA-23879, UEC-28719); Manaus-Caracaraí rd., Km. 148, 27 Sep. 1973, *C. C. Berg 18148* (INPA, MG). **Bahia:** Caetité, Tucano, 15 Mar. 1995, *G. Hatschbach, M. Hatschbach & J. M. Silva 61927* (CEPEC, MBM); Camacã, estrada Rio Branco, plantação de cacao, 27 Jan. 1971, *T. S. Santos 1433* (CEPEC, NY); Ilhéus, Fazenda Santa Maria, 28 Apr. 2001, *R. H. R. Sambuichi 197a* (IAC); Maracás, Faz. Cabloco, Lagoinha, 27 Feb. 2000, *R. P. Oliveira et al. 401* (CEN, HUEFS). **Espírito Santo:** Linhares, Reserva Florestal da CVRD, Estrada Bicuiba, 12 Feb. 1973, *J. Spada 185* (CVRD, UEC); Estrada Cinco folhas, 4 Feb. 1981, *D. A. Folli 307* (CVRD, UEC). **Maranhão:** Barão do Grajaú, Dec. 2005, *I. C. Nascimento Jr. 1659* (UB); Benedito Leite, Faz. Veneza, 23 Jan. 2005, *A. M. Miranda 4762 et al.* (Sergio Tavares, Universidade Federal Rural de Pernambuco, Recife, Pernambuco); Codó, Caxias, s.d., Capanema (RB); Fortuna, lugar Caiçara, a 15 km SE de Fortuna, 21 Feb. 1983, *N. A. Rosa, Rosário, T. Rebbeck, J. B. F. da Silva & M. R. dos Santos 642* (MG, MO-5952102); Codó, 18 June 1907, *A. Ducke s.n.* (MG-623); Grajaú, 42 km due NE of city of Grajaú, on old rd. to Barra do Corda, 10 Feb. 1970, *G. Eiten & L. T. Eiten 10269* (NY, SP, UB); Loreto, Ilha de Balsas region betw. the Balsas & Parnaíba rivers, 7 Feb. 1970, *G. Eiten & L. T. Eiten 10493* (NY, SP, UB); 10 Feb. 1970, *G. Eiten & L. T. Eiten 10543* (NY, SP); Parnarama, Mirindiba, estrada de barro, 1 Mar. 2005, *A. M. Miranda et al. 4914* (Sergio Tavares, Universidade Federal Rural de Pernambuco, Recife, Pernambuco); Santa Barbara due SSE of Loreto, on shore of rio Parnaíba, 1 June 1967, *G. Eiten & L. T. Eiten 4809b* (SP); Santa Luzia, Faz. Agripec.-Varig, caminho para rio Mutum, 5 Apr. 1983, *M. F. F. da Silva 1011* (HRB, IAN, INPA, MG, NY). **Minas Gerais:** Chácara, Jan. 1978, *M. Ponce 15462* (CESJ, UEC); Caratinga, Est. Biol. Caratinga, 19 Dec. 1984, *M. A. Lopes & P. M. Andrade 663* (BHCB); same locality, 19 Jan. 1990, *L. V. Cota s.n.* (BHCB-19254); Matão, 18 Jan. 1985, *P. M. Andrade & M. A. Lopes 591* (UEC); Mata do João, 3 Jan. 1986, *M. A. Lopes & S. F. Ferrari 902* (UEC); Mata do João, 18 Jan. 1986, *M. A. Lopes & S. F. Ferrari 920* (BHCB, UEC); Mata do Jaó, 3 Dec. 2001, *J. V. Gomes 776* (BHCB, MBM, SPF), 18 Jan. 1986, *M. A. Lopes & S. F. Ferrari 883* (BHCB, IAC), 3 Jan. 1986, *M. A. Lopes & S. F. Ferrari 880* (BHCB, IAC); Fazenda Montes Claros, 7 Jan. 1991, *J. R. Stehmann & C. V. Mendonça Filho s.n.* (BHCB-20285); Carandaí, pedra do Sino Hotel Fazenda, BR 040, Km. 6 (RB); Trilha do sagüi, 9 Feb. 2006, *N. F. Mota & D. Souza 568* (BHCB); Dionisio, Parque Estadual do Rio Doce, 3 Feb. 2004, *G. S. França & F. Raggi 506* (BHCB, CESJ); Santana do Riacho, 13 Oct. 2003, *A. Furlan s.n.* (SP-209866), Km. 126, 19 Dec. 1979, *J. R. Pirani s.n.* (SP-186207); Viçosa, Recanto das Cigarras, Reserva Biológica, 20 Dec. 2005, *E. P. Campos 179* (IAC); campus da Universidade Federal de Viçosa, s.d., *A. F. Silva & N. R. Fontes 142* (IAC, RB, VIC); agricultura College Lands, 27 Dec. 1929, *Y. Mexia 4174* (IAN, NY, RB, VIC). **Pará:** Rio Jarí, Serra de Arumanduba, 25 July 1961, *W. A. Egler 45993* (IAN, MG); Altamira, Rio Xingu, Reserva Indigena dos Assurinis, 27 Jan. 1917, *S. A. M. Souza 857* (MG); no Xingu, acampamento base da cachoeira do Espelho, 17 Feb. 1987, *A. T. G. Dias 1174* (MG, SPF); Barcarena, arredores da pousada Japiim, 17 Mar. 2002, *A. S. da Silva 3590* (MG, SP, SPF); Marabá, estrada de Marabá, Km. 45, 24 Jan. 1971, *B. G. S. Ribeiro 38* (IAN); Serra dos Carajás, estrada do Manganês, 19 Jan. 1985, *O. C. Nascimento & R. P. Bahia 922* (MG); Tucuruí, área 4 das obras da UHI, 17 Dec. 1983, *M. F. F. da Silva 443* (HRB, MG). **Piauí:** Boa Hora, Camumbi, próximo à casa de D. Raimunda, 25 June 1999, *A. Ricardo França s.n.* (RB, TEPB-10580); Brasileira, Parque Nacional de Sete Cidades, Baixa do Barreiro (6ª cidade), 23 Jan. 2001, *M. E. Alencar et al. 1163* (TEPB, UEC); Piracuruca, Parque Nacional Sete Cidades, 29 Feb. 1980, *A. J. Castro s.n.* (TEPB-1026); Campo Maior, PI 115, Km. 6, 8 Mar. 1982, *F. M. T. Freire s.n.* (RB-479062, TEPB-2926); Uruçuí, próximo ao rio Uruçuí Preto, margem da estrada, 21 Jan. 2005, *A. M. Miranda et al. 4681* (Sergio Tavares, Universidade Federal Rural de Pernambuco, Recife, Pernambuco). **Rondônia:** Ji-Paraná, travessia da gleba g, 7 Apr. 1983, *M. G. Silva 6107* (INPA, MG); Porto Velho, córrego da Raiz, BR 364, 19 Apr. 1987, *M. Nee 34945* (INPA, SP); Km. 8 da rodovia, 27 June 1952, *J. F. Silva 219* (IAN); Vilhena, Fazenda Flor da Serra, Estrada para Aripuanã, 20 May 1984, *C. S. Rosario 378* (MG). **Roraima:** Boa Vista, rio Branco, June, *J. G. Kuhlmann 488* (RB); margens dos campos altos, 3 July 1937, *A. Ducke s.n.* (RB-35686); Boa Vista–Caracaraí rd. (BR-174), 58 km S of Boa Vista, 31 Jan. 1969, *G. T. Prance 9515* (INPA); Faz. Sacramento, 25 Nov. 1978, *J. L. de*

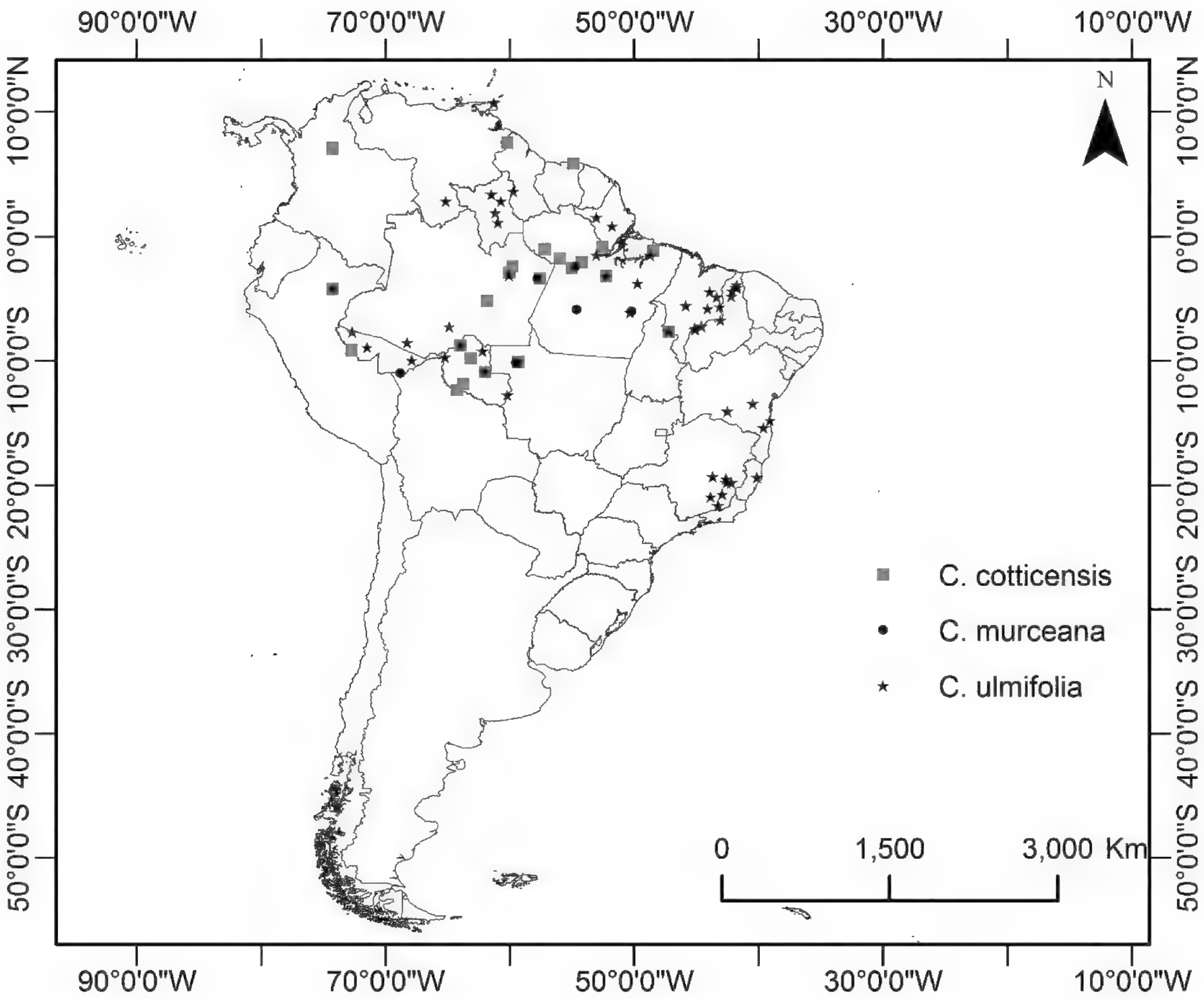

Figure 4. Geographical distribution map of the species of the *Casearia ulmifolia* complex.

Souza 343 (INPA); rd. BR-401, que liga Boa Vista-Bonfim, Km. 3, beira de estrada, 2°50′N, 60°40′W, 31 July 1986, *J. A. Silva et al. 509* (MO-5952099, UB); Sema Ecological Station, Ilha do Maracá, Santa Rosa, 13 Feb. 1987, *J. A. Ratter 5694* (INPA). PERU. **Lamas:** Distr. Alonso de Avaredo, San Juan de Facaícapa, 12 July 1977, *J. Schumke V. 9704* (MG); s.d., *E. F. Poeppig 13665* (IAN). VENEZUELA. **Barinas:** Carretera Barinas, San Cristobal, 14 June 1979, *L. M. Berti & I. Peña 230* (SP, VEN).

Taxonomic discussion. Three distinct taxa are recognized for the *Casearia ulmifolia* complex. The most broadly distributed and variable species, *C. ulmifolia*, can be best distinguished by the glands on the margins of its stipules, the leaves with serrate margins, the oblong anthers with longitudinal dehiscence, the disk lobes with a tetralobate apex, barbate to villous at apex, the sepals glandular at apex, and a pilose ovary apex, especially at insertion with styles. *Casearia murceana* can be best characterized by its apical gland in the stipule, the leaves with sparse teeth or with less serrate margins, the oblong, obovate to ovate anthers with longitudinal dehiscence, the disk lobes with a flattened, clavate apex, the sepals with glands generally present, and the gynoecium with trichomes extending from the middle of the ovary to the top of the style. Finally, *C. cotticensis* is identified by the absence of stipular glands, the leaf margins serrate to serrulate, the deltoid anthers with transverse dehiscence at the base, the disk lobes with a clavate apex, the sepals with glands, and the ovary and style usually glabrous.

Key to the Species of the *Casearia ulmifolia* Complex in Northern South America/Brazil and Adjacent Countries in Northern South America

1a. Leaves coriaceous, blades with primary and secondary veins tomentose, but glabrescent elsewhere, venation prominent on the adaxial face; anthers deltoid, connective developed with glabrous or subglabrous apical gland, anther dehiscence transverse, with openings turned downward; stigma tomentose ..... 1. *C. cotticensis*

1b. Leaves chartaceous or membranaceous, blades tomentose throughout both faces or pilose near the primary vein, venation not prominent on adaxial face; anthers oblong, connective undeveloped, with apical gland barbate to glabrous, anther dehiscence longitudinal, with lateral openings; stigma hirsute 2

2a. Inflorescences sessile; filaments villous, anthers with barbate apical gland; ovary glabrous at base, densely villous from the median portion to the style; cotyledon leaves oblong ..... 2. *C. murceana*

2b. Inflorescences pedunculate to short pedunculate (2–)3–4 mm; filaments glabrous, anthers with glabrous to slightly barbate apical gland; ovary glabrous, tomentose or pubescent at

style insertion, tomentose at style insertion; cotyledon leaves rounded ..... 3. *C. ulmifolia*

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Lozania nunkui (Lacistemataceae), a New Species from the Sandstone Plateaus of the Cordillera del Cóndor in Ecuador and Peru

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ABSTRACT. *Lozania nunkui* D. A. Neill & Asanza (Lacistemataceae), a new species from the Cordillera del Cóndor region of southeastern Ecuador and adjacent northern Peru, is described and illustrated. It is distinguished from other species in the genus by the glabrous, entire, relatively thick and coriaceous, sclerophyllous leaves, and uniquely, by the five or occasionally six sepals, rather than four sepals as in all other known species. The new species is restricted to nutrient-poor, highly acidic sandstone plateaus within its range, and the thick sclerophyllous leaves appear to be an ecological adaptation to that edaphic condition.

RESUMEN. Se describe y se ilustra *Lozania nunkui* D. A. Neill & Asanza (Lacistemataceae), una nueva especie de la región de la Cordillera del Cóndor en el sureste del Ecuador y la zona colindante del norte de Perú. Se distingue de las demás especies del género por las hojas glabras, enteras, relativamente gruesas, coriáceas y esclerófilas, y por los cinco u ocasionalmente seis sépalos, en vez de los cuatro sépalos que presentan todas las demás especies. Dentro de su rango geográfico, la especie nueva está restringida a las mesetas de areniscas, con suelos pobres en nutrientes y muy ácidos, y las hojas gruesas y esclerófilas parecen ser una adaptación ecológica a esa condición edáfica.

Key words: Ecuador, IUCN Red List, Lacistemataceae, *Lozania*, Peru.

Lozania Mutis ex Caldas (Lacistemataceae) is a small Neotropical genus of just four accepted species at present (Sleumer, 1980; Gentry, 1988), with a distribution including southern Central America (southeast Nicaragua to Panama), the tropical Andes (Venezuela to Bolivia), and western Amazonia, including Amazonas, Brazil. All known species are small trees, sometimes shrubby, occurring in the understory of mature-phase moist and wet forests up to ca. 2400 m elevation.

In the Cordillera del Cóndor region of southeastern Ecuador and northern Peru, floristic inventory work in recent years has resulted in collections of a number of undescribed species of trees and shrubs in various genera and families (Neill, 2005; Daly et al., 2012). Most of these undescribed taxa are evidently restricted to the outcrops of Cretaceous sandstone of the Hollín Formation, which constitute about 20% of the land area in the Cordillera del Cóndor region. Some of these substrate-restricted species exhibit morphological features that appear to reflect an ecological adaptation to the highly acidic, nutrient-poor soils that are derived from the sandstone substrate, frequently including glabrous, thick, coriaceous or sclerophyllous leaves. Among these novelties that are evidently local endemics on the sandstone plateaus of the Cordillera del Cóndor, is a species of *Lozania* that we and our colleagues have found on several sandstone outcrops in the region.

Lozania nunkui D. A. Neill & Asanza, sp. nov. TYPE: Ecuador. Morona-Santiago: Limón-Indanza, Cordillera del Cóndor, Centro Shuar Kuankus, summit of Cerro Chuank Naint ("Vulture Mountain" in Shuar), a sandstone massif, 1270 m, 3°3′36″S, 78°14′25″W, 18 Sep. 2005 (fl., fr.), *D. Neill, M. Asanza, W. Quizhpe & C. Morales 14657* (holotype, QCNE; isotypes, AAU, GB, HUT, K, LOJA, MO, NY, US).

Haec species a congeneris foliis satis crassis coriaceisque glabris nitidis integris venatione secondaria tertiariaque prominula atque sepalis 5 vel 6 (nec 4) distinguitur.

Tree attaining 10 m in height with trunk ca. 10 cm diam.; branches glabrous, mostly borne horizontally. Leaves elliptic to elliptic-obovate, broadly obtuse to shortly acuminate at apex, cuneate at base, coriaceous, rather thick, stiff and sclerophyllous, completely glabrous above and below, or glabrescent with a few scattered simple unicellular hairs on the lower surface, with entire margins, the blade (4–)5–10(–11) × (2.5–)3–5 cm, petiole 7–9 mm, glabrous or with a few strigose hairs; leaf surface lustrous, conspicuously glossy on upper surface, somewhat duller beneath, costa impressed above, prominent below; lateral nerves 4 to 7, curved ascending, secondary

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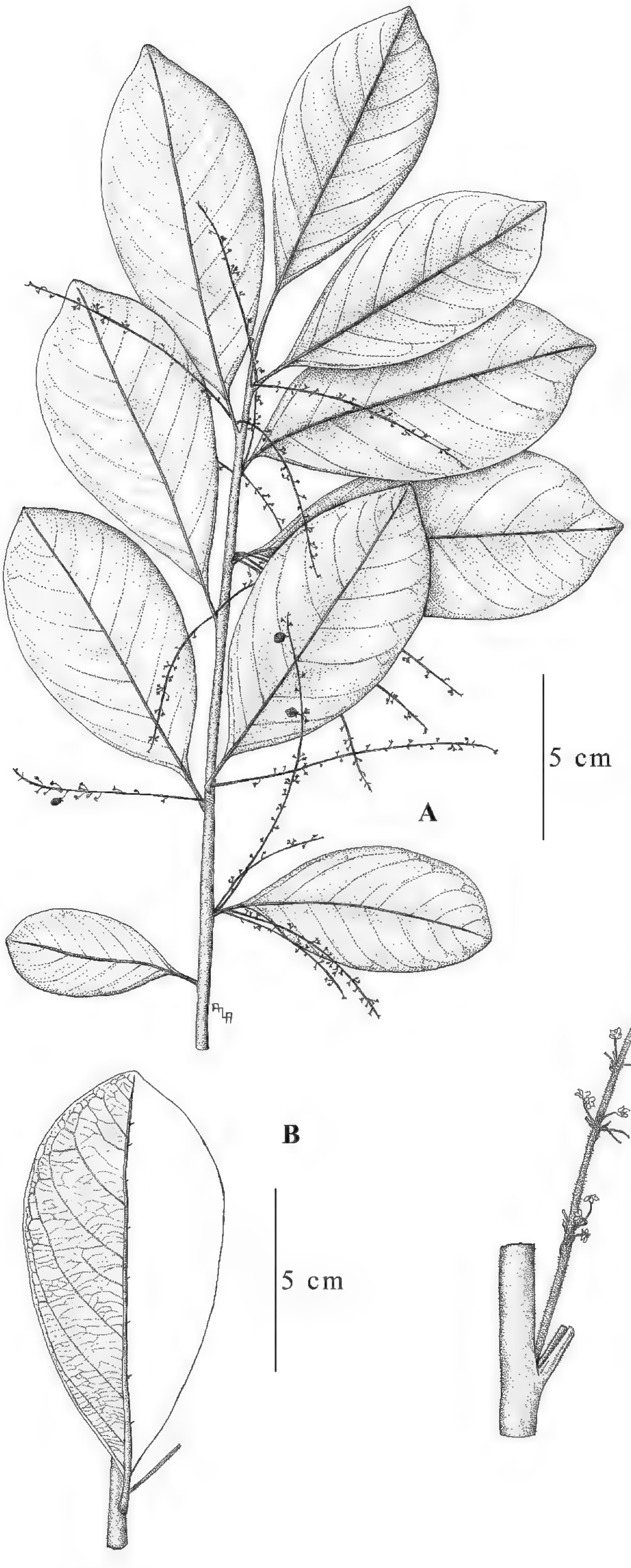

Figure 1. *Lozania nunkui* D. A. Neill & Asanza. —A. Flowering branch. —B. Leaf. —C. Inflorescence. —D. Flower. —E. Fruit. Drawn from the type collection *D. Neill, M. Asanza, W. Quizhpe & C. Morales 14657*.

and tertiary veins prominulous on both surfaces of blade. Inflorescence of axillary racemes, borne on leafy branches, or at nodes where leaves have fallen, on bare branches below leaves, usually 2 or 3 racemes per node, sometimes solitary. Inflorescences 6–10 cm, with strigose hairs on rachis; basal bract with strigose pubescence, obtuse at apex, ca. 0.5 mm, covering the smaller 2 glabrous bracteoles; flowers usually 3 at each node along rachis, with 1–4 mm between nodes along axis of inflorescence; pedicels ca. 2 mm, glabrous, articulate near base; sepals 5 or sometimes 6, broadly spreading, slightly reflexed at anthesis, obovate, obtuse to rounded at apex, ca. 0.8 × 0.6 mm, pale yellow when fresh; petals absent; basal disk annular, rather thick and fleshy; stamen 1, inserted at base of ovary within disk, filament ca. 0.3 mm, rather thick and stout; the 2 anthers forming an obtuse angle at apex of filament; ovary densely strigose-pubescent at anthesis, oblate, ca. 0.5 × 0.4 mm, the blunt apex with 3 reflexed style branches ca. 0.2 mm. Fruit ellipsoid-trigonous, 4–5 mm long and broad, with sparse strigose pubescence or becoming glabrescent, dark purple when ripe, fleshy; seeds usually 2 or 3 per fruit, ca. 3 × 2 mm, with fleshy red-orange sarcotesta.

Distribution and ecology. *Lozania nunkui* has a known geographical range restricted to the sub-Andean cordilleras east of the Eastern Cordillera of the Andes, in the Cordillera del Cóndor of Morona Santiago and Zamora Chinchipe provinces, Ecuador, and in Cajamarca Department, Peru, in an altitudinal range of ca. 1000–1700 m, from ca. 3°00′S to 5°10′S latitude. The only record from Peru was collected in the sub-Andean range known locally as the Cordillera Huarango; this north- to south-trending ridge forms the border between Cajamarca and Amazonas departments, and is actually a southern extension of the Cordillera del Cóndor that forms the Ecuador–Peru border from 3°00′S to 4°30′S. The new taxon has not been recorded on the slopes of the Andes proper, nor in the Amazon lowlands below 1000 m.

All available evidence indicates that this species is ecologically restricted to sandstone or sandstone-derived soils. The known populations of this species all occur on the fragmented sandstone plateaus of the Cretaceous Hollín Formation in the Cordillera del Cóndor region, or on ridges or slopes immediately below the sandstone plateaus, where the soils have a relatively high sand content due to erosion from the sandstone formation above. These highly acidic, oligotrophic soils typically have a pH of about 3.8–4.5, with very low concentrations of N, P, and K and relatively high concentrations of Al and sometimes Fe (D. Neill, unpublished). Typically, the vegetation on such substrates is a relatively low, dense forest, with a dense root mat and thick accumulation of humus. Thick sclerophyllous leaves or leaflets are characteristic of many other trees and shrubs on the sandstone plateaus of the Cordillera del Cóndor as well as the vegetation on white sands in lowland Amazonia (Anderson, 1981). The adaptive significance of sclerophylly remains controversial, and three main hypotheses are current: (1) resistance to drought and seasonal water deficits; (2) adaptation to low-nutrient soils; and (3) enhancement of leaf protection, particularly protection from herbivory (Turner, 1994; Edwards et al., 2000). These adaptive explanations for sclerophylly are not necessarily mutually exclusive. Fine et al. (2004, 2006) conducted reciprocal transplants of white-sand specialists and clay-soil species near Iquitos, Peru, and the experimental results suggest that sclerophylly or leaf toughness, as well as other traits such as increased levels of terpenes or tannins in leaf tissue often found in white-sand specialist species, confer significant protection from herbivores and a significant increase in fitness of white-sand specialist species in their special habitat. With the low nutrient levels in the soil and consequently very slow growth of plants on oligotrophic sandstone or white-sand substrates, the plant's investment to avoid loss of photosynthetic tissue through herbivory is evidently worth the cost.

Given that *Lozania nunkui* is a local endemic restricted to sandstone, and with remarkably more sclerophyllous leaves than its relatives, one may hypothesize that this species evolved in situ from an Andean ancestor within the genus *Lozania* and acquired these traits as an ecological adaptation to the nutrient-poor sandstone substrate. The sandstone plateaus have been available for colonization by plants, concomitant with the geologically recent uplift of the Andes and the erosion of the sediments overlying the Hollín sandstone formation, only in the past 3 to 4 million years (Gregory-Wodzicki, 2000). Because the sandstone plateaus of the Cordillera del Cóndor region are fragmentary and do not comprise a continuous surface, this species has evidently dispersed among the isolated sandstone outcrops over a distance of 250 km from north to south. Future phylogenetic work on *Lozania* may be able to confirm this hypothesis.

IUCN Red List category. *Lozania nunkui* has not been found in any formally protected area in Ecuador or Peru. The discontinuous populations on the several sandstone plateaus where it occurs in the Cordillera del Cóndor region are, in general, not imminently threatened by deforestation or habitat destruction. This may change if mining and other development

activities in the region are considerably expanded and do not take appropriate measures to mitigate their environmental impacts. More long-term impacts such as future climate change could threaten these small, scattered populations. According to the IUCN Red List criteria for estimated range, area of occupancy, and population size, *L. nunkui* should be listed in the category NT or Nearly Threatened (IUCN, 2001).

Phenology. *Lozania nunkui* has been collected in flower in the months of March, April, May, September, and October, and in fruit during most of those months as well. In the aseasonal climate within a few degrees of the equator, the taxon may well flower intermittently throughout the year with no clear-cut phenological pattern, which, as we have observed for a number of years, is the case for many trees in the region.

Etymology. All of the Ecuadorian populations of *Lozania nunkui* are within the ancestral territory of the Shuar, an indigenous group in the Jivaroan language family that now numbers about 110,000 people in southeastern Ecuador. In traditional Shuar mythology, Nunkui, the name we have borrowed for the specific epithet, is the feminine manifestation of the divine spirit, the Shuar goddess of agriculture; in Shuar society, cultivation of subsistence crops in swidden gardens near the home, especially the staple *Manihot esculenta* Crantz, is the work of women. The name nunkui is also used for the regional association of Shuar communities, the Asociación Nunkui in the northern part of the Cordillera del Cóndor, in the watershed of the Río Coangos, where the first several collections of this species were made in 2005.

Discussion. *Lozania nunkui* shares some morphological features with *L. glabrata* A. H. Gentry, which is known only from the type collection from the Pacific coastal area of the Chocó Department, Colombia; both species have glabrous leaves with entire to subentire margins. The other three species of *Lozania*, *L. klugii* (Mansf.) Mansf. from western Amazonia, *L. mutisiana* Schult. from Nicaragua to Bolivia, and *L. pittieri* (S. F. Blake) L. B. Sm. from Nicaragua to Colombia and Venezuela, have leaves that are pubescent beneath with serrulate margins. The leaves of *L. glabrata*, however, are relatively thin and membranaceous, whereas those of *L. nunkui* are considerably thicker, stiff and coriaceous, and sclerophyllous. In *L. glabrata*, uniquely, the staminal filament is split at the apex, separating the two anthers; this feature is not shared with *L. nunkui*. The two glabrous-leaved species are also similar in having the longest inflorescences in the genus, to ca. 10 cm, whereas the remaining three species have inflorescences usually shorter than 6 cm.

Most strikingly, *Lozania nunkui* differs from all other known species in the genus in the number of sepals. All other species have flowers with just four sepals, and this was considered a diagnostic feature of *Lozania* in Sleumer's (1980) monograph that included *Lozania* and *Lacistema* Sw. in Flacourtiaceae. Flowering specimens of *L. nunkui*, however, have five sepals, with occasional flowers in some collections having a sixth sepal. All other morphological features indicate that this species belongs in the genus *Lozania*, but the presence of five (or rarely six) rather than four sepals requires a slight modification of the diagnostic identity of the genus. We have found only one exception to the presence of four sepals in other species of *Lozania*: a collection of *L. klugii* from Miazi in the upper Río Nangaritza watershed of Zamora Chinchipe Province, Ecuador, within the Cordillera del Cóndor region, *J. Jaramillo 14155* (NY, QCA), which has flowers with four sepals and five sepals in the same inflorescence. This specimen was collected in an area where *L. nunkui* also occurs and may represent a case of introgression or hybridization between the two species, but does not share any of the diagnostic morphological features of *L. nunkui* except for sepal number in some of the flowers; the leaves are serrulate and pubescent beneath, and the inflorescence is relatively short as in typical *L. klugii*.

Paratypes. ECUADOR. **Morona Santiago:** Cantón Limón-Indanza, Cordillera del Cóndor, Centro Shuar Warints, 1020 m, 3°09′16″S, 78°14′50″W, 5 Oct. 2002 (fl.), *C. Kajekai 10* (MO, QCNE); Cerro Maka Naint, 1600 m, 3°10′59″S, 78°17′57″W, 7 Oct. 2002 (fl.), *T. Katan 25* (MO, QCNE); Centro Shuar Kuankus, cumbre del Cerro Chuank Naint, 1250 m, 03°03′40″S, 78°14′21″W, 19 June 2005 (fl.), *T. Katan 318* (MO, QCNE); Centro Shuar Yunkumas, Cerro Chuank Naint, collections made near 1-hectare forest inventory plot, 1150 m, 3°03′34″S, 78°14′45″W, 17 Sep. 2005 (fl.), *D. Neill & NSF Dendrology Course 14632* (MO, QCNE), *14812* (MO, QCNE), *14822* (MO, QCNE); Cerro Chuank Naint, 1130 m, 3°03′31″S, 78°14′48″W, 19 Dec. 2005 (fl.), *A. Wisum 318* (MO, QCNE), 1150 m, 19 Dec. 2005 (fl.), *C. Morales 1579* (MO, QCNE), 20 Dec. 2005 (fl.), *C. Kajekai 256* (MO, QCNE). **Zamora Chinchipe:** Cantón El Pangui, Cordillera del Cóndor, Cuenca alta del Río Wawaime, afluyente del Río Quimi, 1500 m, 3°35′06″S, 78°26′18″W, 28 Sep. 2006 (fl.), *W. Quizhpe 2319* (LOJA, MO, QCNE); 1660 m, 3°35′17″S, 78°26′16″W, 30 Sep. 2006 (fr.), *W. Quizhpe & A. Wisum 2385* (LOJA, MO, QCNE); 1400–1600 m, 3°34′11″S, 78°25′38″W, 23 Oct. 2006 (fl.), *H. van der Werff & W. Quizhpe 21633* (MO, QCNE); 1510 m, 3°34′05″S, 78°26′22″W, 2 Apr. 2007 (fl.), *C. Kajekai 1196* (MO, QCNE); Contrafuerte Tres Patines, S of Río Tundayme, above the military rd. to Cóndor Mirador, 1680 m, 3°37′49″S, 78°26′50″W, 23 Sep. 2007 (fl.), *D. Neill, C.*

Davidson & S. Christoph 15951 (LOJA, MO, QCNE); Cantón Yantzaza, 1 km N of Río Machinaza at Las Peñas, ridgetop with Hollín sandstone substrate, 1640 m, 3°46′33″S, 78°29′46W″, 20 Mar. 2008 (fls.), *D. Neill & W. Quizhpe 16253* (LOJA, MO, QCNE); Cantón Nangaritza, upper Río Nangaritza, Area de Conservación Los Tepuyes, on upper portion of sloping sandstone plateau SW of Las Orquídeas, in & near 1-hectare forest inventory plot, 1620 m, 4°15′32″S, 78°41′04″W, 6 Nov. 2006 (fl.), *D. Neill & NSF Dendrology Course 15431* (LOJA, MO, QCNE). PERU. **Cajamarca:** San Ignacio, Distr. Huarango, poblado Huarandoza, caserío El Edén, camino al cerro de arena blanca, bosque enano, 1697 m, 5°10′37″S, 78°44′27″W, 23 May 2007 (fl., fr.), *J. Perea & V. Flores 3259* (MO, USM).

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Clethra concordia (Clethraceae), a Shrubby New Species from the Crest of the Cordillera del Cóndor on the Peru–Ecuador Border

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Abstract. *Clethra concordia* D. A. Neill, H. Beltrán & Quizhpe (Clethraceae), a thin-stemmed shrub or treelet from the sandstone Machinaza plateau in the Cordillera del Cóndor region on the Peru–Ecuador border, is described and illustrated. The new species is distinct from other species of *Clethra* L. in its small stature and its very small, thick sclerophyllous leaves, which are evidently an ecological adaptation to the highly acidic, nutrient-poor sandstone substrate where it occurs.

Resumen. Se describe y se ilustra *Clethra concordia*, D. A. Neill, H. Beltrán & Quizhpe (Clethraceae), un arbusto o arbolito con tallos delgados, procedente de la meseta de Machinaza, de roca arenisca, en la región de la Cordillera del Cóndor en la frontera entre Perú y Ecuador. La especie nueva se distingue de las demás especies de *Clethra* L. en su estatura pequeña y en las hojas muy pequeñas, gruesas y escleróFilas, las que evidentemente constituyen una adaptación al substrato de arenisca muy ácido y pobre en nutrientes, en donde se encuentra esta especie.

Key words: *Clethra*, Clethraceae, Ecuador, IUCN Red List, Peru.

Clethra L. is a widespread genus with ca. 70 to 80 species distributed in warm temperate areas and tropics of the Western Hemisphere from the southeastern United States to southern Brazil, in warm temperate and tropical eastern Asia from southern China to Malaysia, and on the Atlantic island of Madeira (Sleumer, 1967; Hamilton, 1985; Fior et al., 2003). *Clethra* has traditionally been considered the sole genus in Clethraceae, but recent evidence (Anderberg & Zhang, 2002) suggests that the Neotropical genus *Purdiaea* Planch. should be placed in Clethraceae rather than its traditional position in Cyrillaceae. Within *Clethra*, about 45 species are found in the Neotropics, from Mexico south to southern Brazil and northern Argentina, mostly in montane forests of the Mesoamerican isthmus and in the tropical Andes. Nine species have been reported for Ecuador (Gustafsson, 1992) and 11 species for Peru (Brako & Zarucchi, 1993). All of the Neotropical species are placed in *Clethra* sect. *Cuellaria* (Ruiz & Pav.) DC., characterized by the evergreen, persistent leaves and the flowers with stamens and styles included. Most of the Neotropical *Clethra* species are mid-sized canopy or subcanopy trees, attaining at least 10 m in height, although some species are found in flower or fruit as shrubs of 3–5 m in height, particularly those species that grow at high elevations or at forest edges.

The Cordillera del Cóndor is an eastern outlier of the main Andean chain that extends about 150 km from north to south and forms part of the international border between southeastern Ecuador and northern Peru. The geology of the Cóndor range is complex; one of the sedimentary strata that make up the Cóndor is the crystalline sandstone Hollín formation of mid-Cretaceous age, which has been uplifted and exposed with the rise of the Andes in the last 3 to 4 million years (Gregory-Wodzicki, 2000) to form a discontinuous series of flat-topped or inclined plateaus, sandstone fragments that vary in size from a few hectares to 20–30 km² in size, at elevations from 300 m to ca. 2900 m. The soil derived from the crystalline white quartzsite bedrock of the Hollín formation is highly acidic and very poor in N, P, K, and other nutrients essential for plant growth, so as in other areas with oligotrophic white sand or sandstone-

derived soils, the vegetation on the sandstone plateaus of the Cóndor is relatively low in stature, and many of the plants that grow there have relatively small, thick, coriaceous, and sclerophyllous leaves (Neill, 2005).

The sandstone outcrops at 2000 m elevation and higher in the Cordillera del Cóndor generally have a dense, low scrublike vegetation, ca. 3 m tall, or lower at higher elevations. Some of the shrubby dominants with thick sclerophyllous leaves in this vegetation are locally endemic species of genera that normally are mid-size canopy or subcanopy trees in Andean cloud forests; an example is *Weinmannia* L. (Cunoniaceae) for which three dwarf, shrubby species with small sclerophyllous leaves, locally endemic to the Cordillera del Cóndor, have been described recently (Rogers, 2002a, 2002b) in this genus of mostly Andean trees. We describe herein another example in the genus *Clethra*, a species known from just one sandstone plateau fragment of the Cordillera del Cóndor that is very distinctive in its small stature and small sclerophyllous leaves.

Clethra concordia D. A. Neill, H. Beltrán & Quizhpe, sp. nov. TYPE: Ecuador. Zamora Chinchipe: Cantón Centinela del Cóndor, Cordillera del Cóndor, Machinaza plateau summit area, adjacent to obelisk-shaped border marker, at end of trail from upper Paquisha military post, precisely at Ecuador–Peru border, 2400 m, 03°53′50″S, 78°28′49″W, 15 Mar. 2008 (fl., fr.), *D. Neill & W. Quizhpe 16200* (holotype, QCNE-222802; isotypes, AAU, F, GB, HUT, K, LOJA, MO, NY, QCA, QCNE, US, USM). Figures 1, 2.

Figure 1. *Clethra concordia* D. A. Neill, H. Beltrán & Quizhpe, growing in scrub vegetation at the type locality on the Machinaza plateau at 2400 m elevation. Photo by David Neill.

Haec species a congeneris statura minore, foliis reductissimis rigidis crassis coriaceis usque ad 1.8 cm longis ad apicem dentibus 1 ad 9 gracilibus praeditis atque inflorescentia terminali racemosa solitaria recedit.

Thin-stemmed shrubs or treelets, to 2 m tall, but flowering and fruiting at 1 m tall or less, often with a single, unbranched erect trunk 2–3 cm diam., or with a few erect or ascending branches terminating in erect inflorescences. Leaves borne erect on erect or steeply ascending branches, or on the unbranched trunk, the blades of adjacent leaves overlapping and clasping the branch; leaves very stiff and brittle, coriaceous and sclerophyllous, the blade elliptic, ovate or slightly obovate, 0.9–1.5(–1.8) × 0.4–0.8 cm, apex obtuse or acuminate, base obtuse; margin entire along the basal 2/3, usually with 3 to 9 prominent slender marginal teeth 1–1.5 mm long along the apical 1/3 of the blade, each marginal tooth terminating a lateral vein, sometimes entire except for a single apical tooth; adaxial surface glabrous or with a few scattered stellate hairs on young leaves, so glabrescent, abaxial surface glabrous or with a few simple unbranched hairs along the costa and margin; costa impressed above, prominent below, 3 to 5 pairs of lateral veins, prominulous on both surfaces or sometimes rather inconspicuous, the veins often reddish on fresh leaves. Inflorescence a compact raceme, terminal and erect on erect leafy branches, 2–3 cm, with up to 15 flowers per raceme; inflorescence axis, bracts and pedicels minutely tomentose with reddish brown stellate hairs, bracts linear-subulate, 4–6 mm; pedicels to 7 mm. Sepals 5, ovate, 3 × 2 mm, broadly acute at apex, truncate at base; adaxial surface glabrous or with scattered unbranched hairs; abaxial surface densely tomentose with inner layer of minute stellate hairs and outer one of larger, unbranched fasciculate hairs, the indument reddish brown; petals 5, white, broadly obovate, 5 × 3 mm, broadly rounded at apex, truncate at base, slightly cucullate, imbricate at anthesis, forming an

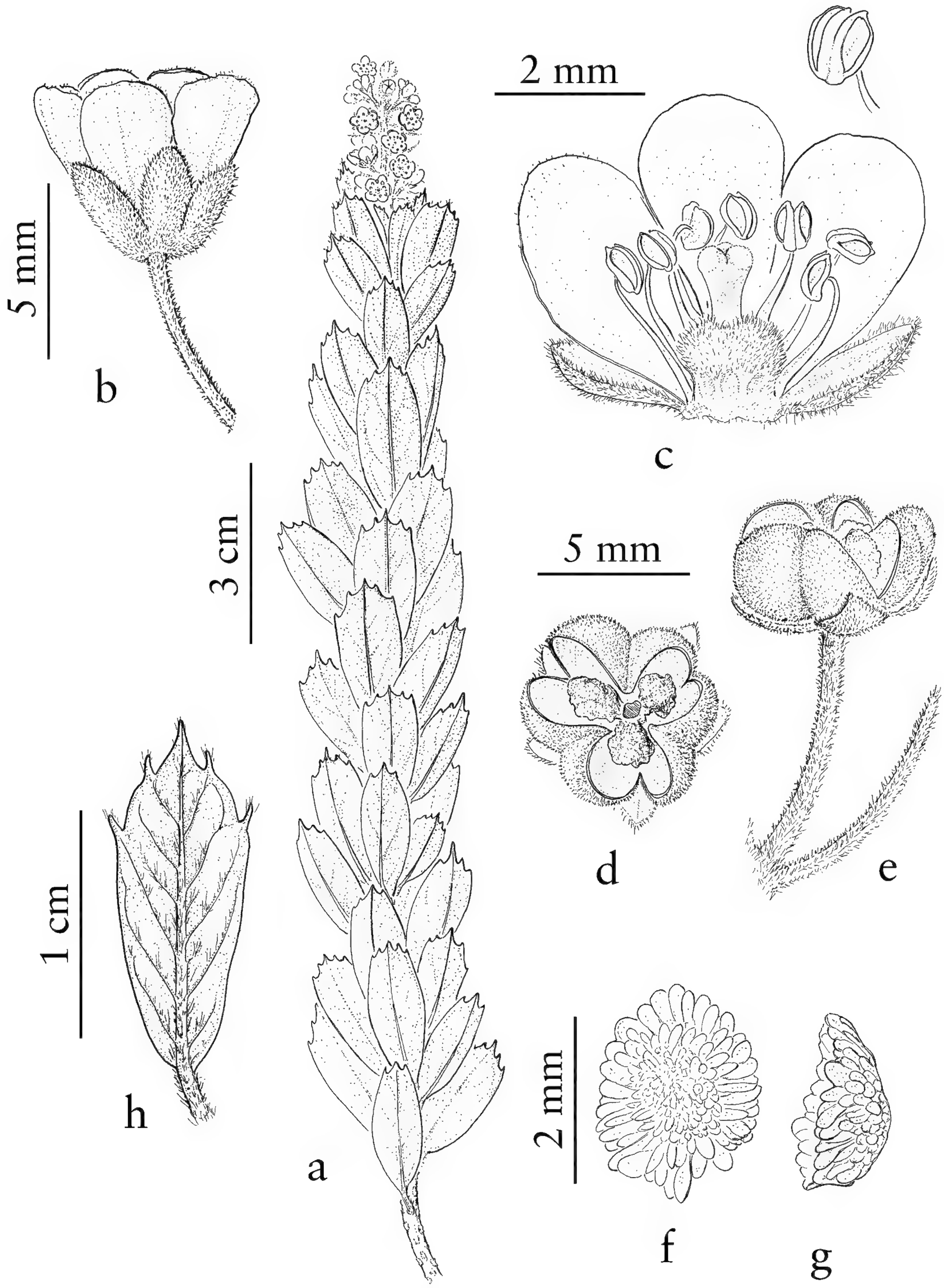

Figure 2. *Clethra concordia* D. A. Neill, H. Beltrán & Quizhpe. —A. Erect flowering branch with erect inflorescence. —B. Flower, side view. —C. Flower interior showing stamens and pistil. —D. Dehisced fruit, top view. —E. Dehisced fruit, side view. —F. Seed, top view. —G. Seed, side view. —H. Leaf. Drawn from *Beltrán & Foster 1501* (MO).

urceolate corolla open at the apex, and later opening more widely to form an open cupular corolla; stamens 10, filaments 3 mm, anthers yellow, ca. 1 mm, ovary densely pubescent with minute stellate reddish brown hairs, style ca. 1 mm, bluntly 3-lobed. Capsule 3-valved, 2–3 mm long, 4–5 mm diam., to 6–7 mm diam. after dehiscence, minutely puberulent with stellate hairs; seeds broadly elliptic, compressed, ca.

2×1 mm, with a lacerate wing formed by inflated cells of the testa.

Distribution and ecology. *Clethra concordia* is known from just two localities, one in Ecuador and one in Peru, about 7 km apart on the summit of the nearly level Machinaza plateau. This is one of the largest and highest of the sandstone plateaus in the Cordillera del Cóndor, and it sits astride the international border. The western part of the plateau, on the Ecuadorian side, is in the watershed of the Río Machinaza, a tributary of the Río Zamora; the eastern portion, on the Peruvian side, is in the watershed of the Río Comainas, a tributary of the Río Cenepa that drains into the Río Marañón; the watershed boundary is hardly recognizable on this flat plateau, but it constitutes the international border. The entire Machinaza plateau, mostly at 2300–2400 m, but dipping to about 2150 m at the eastern margin, covers an area of ca. 15 km^2, and comprises the only known area of occurrence and suitable habitat for *C. concordia*. The vegetation on this plateau is a low, rather sparse scrub, with shrubs mostly less than 1.5 m tall. Among the shrubby species that co-occur with *C. concordia* is *Weinmannia condorensis* Z. S. Rogers, another example of a low, shrubby plant with very small, sclerophyllous leaves whose congeners are mostly Andean trees with larger, thinner, more mesophyllous leaves. Several other shrubs in various plant families at this site are believed to be locally endemic species not yet known to science (Neill, pers. obs.). Fragments of charred stems indicate that the area was burned over in the past, probably in the 1980s or early 1990s. There are other sandstone plateaus in the Ecuadorian portion of the Cordillera del Cóndor, mostly below 2000 m elevation, with a somewhat taller and denser scrub vegetation, but *C. concordia* has not been found at any other locality.

The adaptive advantage of thick, stiff, sclerophyllous leaves, which *Clethra concordia* shares with many other species that are edaphically restricted to oligotrophic white-sand or sandstone-derived soils, appears to be related to protection from herbivory, since the loss of hard-won leaf tissue would threaten the survival of the plant to an extent that outweighs the energetic cost of sclerophylly (Turner, 1994). This hypothesis has been tested experimentally in lowland Amazonian white-sand forests by Fine et al. (2004, 2006). Several other recently described species from the sandstone plateaus of the Cordillera del Cóndor, such as *Dacryodes uruts-kunchae* Daly, M. C. Martínez & D. A. Neill (Burseraceae), also have small, thick sclerophyllous leaves. There is a more thorough discussion of the adaptive advantage and evolution of sclerophylly in plants of that region in an article by Daly et al. (2012).

IUCN Red List category. *Clethra concordia*, although it occurs in two countries, is known from a single population with an area of occupancy of less than 20 km^2, as far as is known. Although the population is not imminently threatened, it may be prone to unforeseen stochastic events such as a brush fire in a year of dry weather, or rapid climate change. Under these criteria (IUCN, 2001), this species should be listed in the IUCN category of Vulnerable (VU).

Etymology. The specific epithet "concordia" is a compound word from the Latin, translated literally as "with hearts" or "with hearts (working) together," and denoting harmony and peace. The epithet commemorates the peace accords and treaty signed by the presidents of Ecuador and Peru in 1998, and ratified by the respective legislatures of those countries, in the culmination of the diplomatic negotiations following the 1995 border dispute between the two countries, the War of Cenepa. Some of the heaviest fighting took place at this site in January to February 1995, and the armies of both Ecuador and Peru planted lethal land mines in the scrub vegetation on the Machinaza summit where *Clethra concordia* is locally common. After the 1998 treaty that established the international border once and for all, a path was cleared through the mine field in order to place an obelisk-shaped boundary marker, a *hito* in Spanish. Two of the authors of *C. concordia* represent the community of botanists of Peru and Ecuador, and we hope the name will serve as a reminder and *hito* of our peaceful bi-national collaboration in scientific endeavors. The epithet is also an anagram of "condorica," which denotes the geographical distribution of this species.

Discussion. The reduced stature and small, thick, coriaceous leaves of *Clethra concordia* are extremes within the genus, such that, based on vegetative characters, specimens of this taxon are not readily recognizable as *Clethra*, and for that reason, the original material collected in Peru in 1994 languished in the family indet cabinets in the herbarium of the Field Museum, Chicago, for a decade, until a look at the 3-valved capsule triggered a flash of recognition in the mind of the senior author. Among its Andean congeners, *C. concordia* is mostly closely approached by *C. ovalifolia* Turcz., a species that ranges from Andean Venezuela to northern Peru (Sleumer, 1967; Gustafsson, 1992) in its shrubby stature and small, glabrous or glabrate leaves, but the

leaves of the latter are at least 3 cm in length and are mostly 4–7 cm long, whereas those of *C. concordia* are 0.9–1.5(–1.8) cm long. Some other species of *Clethra* are rather shrubby, including *C. ovalifolia*, but *C. concordia* is extreme in its short and diminutive stature, rarely more than 1.5 m tall, and often with a single unbranched stem or sparsely branched. The leaves of *C. ovalifolia* are usually uniformly serrate with very small serrations or sometimes nearly entire, whereas the leaves of *C. concordia* have fewer teeth that are longer and more prominent in relation to the size of the leaf, but only on the apical 1/3 of the leaf margin. The inflorescence of *C. concordia*, like its congeners, is a terminal raceme, but in all other Neotropical species in *Clethra* sect. *Cuellaria* the racemes are clustered into rather dense fascicles or panicles, with at least three and usually five to eight racemes per fascicle, whereas in *C. concordia* the racemes are always solitary and strictly erect or sub-erect on erect branches.

Paratypes. ECUADOR. **Zamora Chinchipe:** Cordillera del Cóndor, Machinaza plateau, 2400 m, same locality & date as the type (fl.), *D. Neill & W. Quizhpe 16126* (LOJA, MO, QCNE), (fr.), *D. Neill & W. Quizhpe 16127* (LOJA, MO, QCNE). PERU. **Amazonas:** Condorcanqui, Cordillera del Cóndor, la cima del tepui Cerro Machinaza, cabeceras del Río Comainas, tributario al O del Río Cenepa; arriba de Puesto de Vigilancia Alfonso Ugarte (PV3), subiendo atrás y N del camp., 03°52′42″S, 78°25′48″W, 2160 m, 30 July 1994 (fl., fr.), *H. Beltrán & R. Foster 1501* (F, MO, USM).

Acknowledgments. We thank Robin Foster for making available the 1994 Peruvian collections of this species at F, John Myers for the fine illustration, and Roy Gereau for help with the Latin diagnosis. The 1994 Peruvian collections were made during an expedition sponsored and financed by Conservation International (Schulenberg & Awbrey, 1997). The 2008 Ecuadorian collections were made during fieldwork for an environmental impact study by Cardno Entrix, Inc. for Kinross Aurelian Corp. We thank the Ecuadorian military personnel at the Paquisha Alta post, who helped us reach the Machinaza plateau.

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Two Taxonomic Innovations in South American *Gentianella* (Gentianaceae)

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Abstract. *Gentianella undulatisepala* J. S. Pringle, a new species from Bolivia, is described for the Gentianaceae. It is distinguished from other solitary-flowered species in La Paz Department by its long pedicels and the undulate margins of its calyx lobes. *Gentianella arenarioides* (Gilg) J. S. Pringle is restored to accepted taxonomic status, with the name neotypified, and the new nomenclatural combination is published.

Resumen. Se describe por las Gencianáceas *Gentianella undulatisepala* J. S. Pringle, una nueva especie de Bolivia. Se diferencia de las otras especies de flores solitarias en el Departamento de La Paz por los pedicelos largos y los márgenes ondulados de los lóbulos del cáliz. *Gentianella arenarioides* (Gilg) J. S. Pringle se restaura al estado taxonómico aceptado, con el nombre neotypificado, y la combinación de nomenclatura nueva se publica.

Key words: Bolivia, Gentianaceae, *Gentianella*, IUCN Red List, Peru.

New species of *Gentianella* Moench continue to be discovered in the Andes of South America, and additional collections of previously described taxa permit improvements in the classification of *Gentianella* in this region of its greatest diversity. In the present study, one new species is described and another is restored to taxonomic acceptance and nomenclaturally transferred.

1. Gentianella arenarioides (Gilg) J. S. Pringle, comb. nov. Basionym: *Gentiana arenarioides* Gilg, Repert. Spec. Nov. Regni Veg. 2: 39. 1906. TYPE: Peru. Cajamarca: Prov. Cajamarca, Cajamarca–Bambamarca rd., 55 km N of Cajamarca, 78°35′W, 6°55′S, natural grassland, glaciated terrain, 3750 m, 2 June 1984, *D. N. Smith & I. Sánchez Vega 7433* (neotype, designated here, MO; isotype, HAM).

Distribution. As no specimens of *Gentianella arenarioides* were previously known to be extant, three other collections are cited here, two from Cajamarca Department and one that extends the known range to La Libertad Department.

IUCN Red List category. Data remain deficient for any recommended status in the IUCN Red List (Data Deficient [DD], IUCN, 2001).

Discussion. *Gentiana arenarioides* (1906) was described from a single specimen formerly at Berlin (B), no longer extant, *A. Weberbauer 3995* (B images at F and MO), from Cajamarca, Peru. No other specimens so identified were subsequently cited by Macbride (1959). Fabris (1958) included this name at species rank in the synonymy of *Gentianella graminea* (Kunth) Fabris, noting that the depth of calyx lobing, used by Gilg (1916) as a key character to distinguish these species, is variable and does not differ significantly between the two. In Brako and Zarucchi (1993), I accepted this synonymy, but from the study of specimens seen more recently I conclude that these species are distinct. *Gentianella arenarioides* differs from *G. graminea* in that its flowers are generally solitary, rarely in twos or threes, on peduncles or pedicels 2–10 cm long. In *G. graminea*, even the shorter stems generally bear a corymboid inflorescence of three to eight or more flowers, and the central pedicels are generally less than 2.5 cm, although the lowest are sometimes longer. The corolla lobes of *G. arenarioides* are widely spatulate to obovate, 1.4–1.8× as long as wide, widest at 0.65–0.8× their length, while those of *G. graminea* are oblanceolate, 2–3× as long as wide, widest at 0.55–0.6× their length. The transition from the crowded basal leaves to the widely spaced cauline leaves is more abrupt in *G. arenarioides* than in *G. graminea*.

Gilg (1906) and Macbride (1959) noted the similarity of *Gentiana arenarioides* to *G. tristicha* Gilg (now *Gentianella tristicha* (Gilg) J. S. Pringle, within which I here include *G. lilacina* (Gilg) Zarucchi and *G. mesembryanthemoides* (Gilg) T. N. Ho & S. W. Liu) of Ancash Department. Plants of *G. tristicha* are larger than those of *G. arenarioides*, with stems usually over 20 cm tall, mostly whorled leaves 1–2.5(–3) mm wide, and three to many flowers per stem. The stems of *G. arenarioides* are generally less

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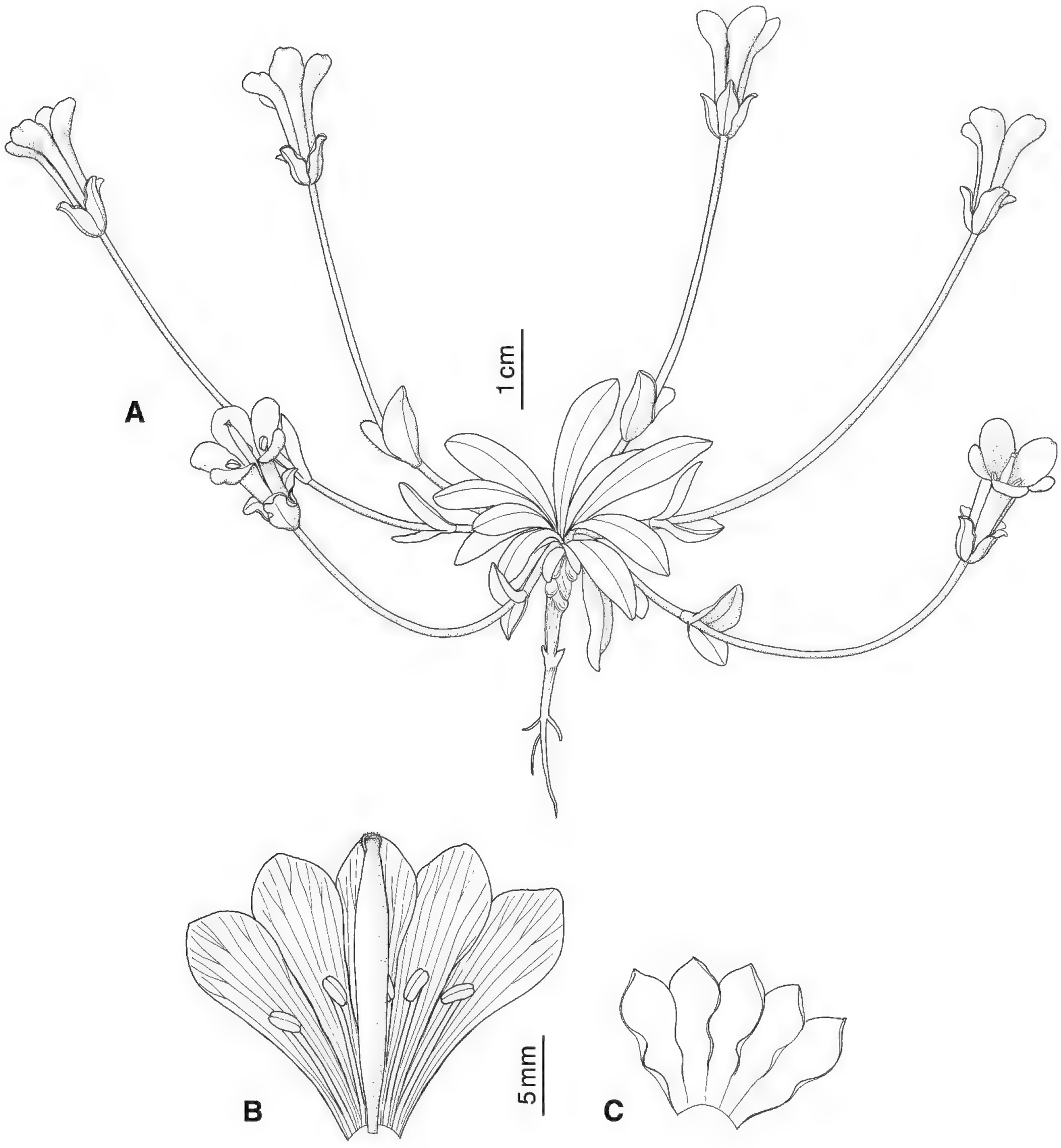

Figure 1. *Gentianella undulatisepala* J. S. Pringle. —A. Flowering plant. —B. Corolla, adaxial view, with stamens and pistil. —C. Calyx, abaxial view. Drawn from the holotype, *X. Menhofer X-1827* (HAM).

than 20 cm, and the leaves of the flowering stems are opposite and narrower, 0.8–1.2 mm wide.

Additional specimens examined. PERU. **Cajamarca:** *A. López M. et al. 7834* and *7842* (HUT not seen, MO); *I. Sánchez V. et al. 12708* (CPUN not seen, F, HAM); *D. N. Smith & I. Sánchez V. 4267* (MO); *M. Weigend et al. 98/525* (MO). **La Libertad:** *A. López M. & A. Sagástegui A. 8188* (HAM, HUT not seen, MO).

2. Gentianella undulatisepala J. S. Pringle, sp. nov. TYPE: Bolivia. La Paz: Prov. B. Saavedra, pajonal humedo y poco pastoreado en el camino de Charazani a Huayrapata, 3950 m, 12 Jan. 1983, *X. Menhofer X-1827* (holotype, HAM; isotype, LPB, digital image seen). Figure 1.

Herba perennis caespitosa inter *Gentianellas* bolivianas floribus solitariis atque corolla pro maxima parte alba lobis quam tubo longioribus praeditas pedunculis longioribus, lobis calycis marginibus valde undulatis etiam corolla fere omino alba distiguenda.

Caespitose perennial, apparently spreading as new tufts of stems arise from rhizomes; vegetative rosettes present along with flowering stems, the latter concurrently 1 to 4, decumbent, 1–6 cm long below

peduncle. Leaves of flowering stems in 1 to 4 pairs, separated by internodes to 3 cm. Leaves elliptic to narrowly obovate or occasionally nearly linear, 3-nerved but with only the midrib prominent, 8–16 × 1.5–5 mm, apices abruptly acute; bases of proximal leaves connate-sheathing 1.5–2 mm, distal cauline leaves with shorter sheaths or scarcely sheathing; decurrent margins forming narrow, sharp ridges on sheaths and on stem below nodes. Leaf and calyx-lobe margins thickened, these and ridges on stem below leaf margins minutely papillose-denticulate. Flowers usually solitary, occasionally with a second flower axillary or on a very short branch, erect; peduncles 25–55 mm, purple. Calyx 7–12 mm, green, midveins and commissural veins ridged, these and margins contrastingly outlined with purple; calyx lobes ovate-oblong to elliptic, 5–8 × 1–2.6 mm, mostly 1.5–3× as long as the tube, abruptly acute, margins undulate; corolla obconic-campanulate, 15–20 mm, white, without markings or suffusions or with slight purple suffusion along veins near base, glabrous within; corolla lobes obovate, 12–16 × 4–6 mm, 3–4× as long as tube, 2.8–3.5× as long as wide, rounded to subacute at apex; stamen filaments inserted at ca. 0.2× the height of the corolla; ovarian stipe not sharply differentiated, ca. 2 mm at flowering time. Fruit not seen.

Habitat and phenology. *Gentianella undulatisepala* is known only from the type collection. Information on its habitat is limited to the label data, quoted above. The January date of this collection provides the only information available on its phenology.

IUCN Red List category. Data are deficient for the recommended listing, according to the IUCN Red List criteria (DD or Data Deficient, IUCN, 2001).

Etymology. *Gentianella undulatisepala* is named for the undulate margins of the calyx lobes, which, to a North American botanist, are reminiscent of the leaves of *Asclepias amplexicaulis* Sm. (Apocynaceae).

Discussion. *Gentianella undulatisepala* is a distinctive species, not obviously most closely related to any one of the several other Bolivian species of *Gentianella* with solitary flowers, largely white corollas, and corolla lobes longer than the tube, of which those most similar to *G. undulatisepala* are noted below. It differs from all other such species in its much longer peduncles; in the other Bolivian *Gentianella* species sharing those traits, the peduncles are generally less than 25 mm. It also differs from all other such species in its ovate-oblong to elliptic, abruptly acute calyx lobes with undulate-fluted margins; in the other species mentioned below, the calyx lobes are lanceolate to ovate-triangular, tapering more gradually toward the apex, and the margins of the calyx lobes are flat. In contrast to the almost completely white corollas of *G. undulatisepala*, the corollas of *G. bockii* (Gilg) T. N. Ho & S. W. Liu and *G. neomandonii* (R. C. Foster) T. N. Ho & S. W. Liu are predominantly white with a dark blue-violet zone near the base of the lobes and the veins are prominently outlined in blue-violet. In *G. sandiensis* (Gilg) J. S. Pringle, the corolla lobes are white with a rather sharply demarcated violet zone along or near the outer margin, extending to the apex. *Gentianella briquetiana* (Gilg) T. N. Ho & S. W. Liu is similar to *G. sandiensis*, but differs from both that species and *G. undulatisepala* in its widely ovate calyx lobes, which are distinctly shorter than the tube.

Acknowledgments. I am grateful to Stephan G. Beck of the Herbario Nacional de Bolivia for a gift of specimens, including the type of the name *Gentianella undulatisepala*, to HAM, and for images of several additional plants from that collection. I am pleased to illustrate this species with the drawing by Barbara Alongi.

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Nectandra ovatocaudata, a New Species of Lauraceae from Cajamarca, Peru

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Abstract. A new species of *Nectandra* Rol. ex Rottb. (Lauraceae) from Cajamarca, Peru, is described and illustrated. *Nectandra ovatocaudata* Rohwer appears to be related to *N. amazonum* Nees, but differs in its leaf shape, in having a receptacle that is densely pubescent inside, and in its habitat.

Key words: IUCN Red List, Lauraceae, *Nectandra*, Peru.

With 114 species recognized in the most recent monograph (Rohwer, 1993), *Nectandra* Rol. ex Rottb. is the second largest genus of Lauraceae in the Neotropics (*Ocotea* Aubl. is estimated to have ca. 300 spp.). To my knowledge, only two new species have subsequently been added, *N. roberto-andinoi* (C. Nelson) C. Nelson (Nelson Sutherland, 2001) and *N. tomentosa* van der Werff (2003). Among the Neotropical Lauraceae, *Nectandra* is traditionally characterized by bisexual flowers with nine tetrasporangiate anthers in which the pollen sacs are arranged in a horizontal row or a shallow arc. In addition, the six tepals of the flower are horizontally spreading at anthesis, usually brilliant white on their adaxial side (as if covered with frost, due to a papillose surface), and somewhat fused at the base, both among themselves and with the filaments of the stamens and staminodes, so that the perianth and androecium drop off as a ring after anthesis. Very often, but not in every species, the anthers are papillose as well and distinctly prolonged beyond the pollen sacs. This combination of characters makes *Nectandra* relatively easy to recognize when in flower, but nevertheless preliminary data (Chanderbali et al., 2001; J. G. Rohwer, unpublished) suggest that it is not monophyletic, with the 21 species of the *N. coriacea* (Sw.) Griseb. group sensu Rohwer (1993) forming a clade separate from the remaining species.

When looking through recently collected material, Henk van der Werff (Missouri Botanical Garden, St. Louis) found some specimens that would not fit any of the species described in the most recent monograph (Rohwer, 1993), and so he asked for my opinion about these. Some of them could be regarded as extreme forms of variable species complexes, and in some the available material was not yet adequate for a description, but two collections representing a new species appeared to be both distinctive and complete enough for description. This species is described below.

Nectandra ovatocaudata Rohwer, sp. nov. TYPE: Peru. Cajamarca: Prov. San Ignacio, Distr. San José de Lourdes, Poblado Los Llanos, bosque alrededor de la comunidad, 05°06′16″S, 078°51′11″W, 1860 m, 10 Oct. 2006 (fl.), *J. Perea & V. Flores 2815* (holotype, MO-6150301; isotypes, HBG, MO-6150300, USM not seen). Figure 1.

Species ut videtur inter *Nectandram amazonum* Nees et *N. laurel* Klotzsch ex Nees intermedia, sed a hac indumento foliorum abaxialiter brevi adpressoque et venulis tertiariis minus prominentibus, ab illa foliis ad basem late rotundatis et receptaculo intus dense pubescente, ab ambabus floribus minoribus differt.

Small tree, 5–6 m (according to type label); twigs roundish-angular, 5 cm below terminal bud 2.3–3 mm diam., initially densely covered with short (< 0.2 mm), appressed, brownish trichomes pointing toward branch apices, this pubescence on older parts of the twig largely worn off; terminal buds elongate, densely covered with similar indument. Leaves alternate or in the distal, flowering parts of the twigs often subopposite; petioles 15–20 × 1.3–3 mm (10–15 × 1–1.5 mm in the inflorescence region), roundish below, flat to slightly canaliculate above, with an indument as on twigs; lamina (ovate to) elongate-ovate to lanceolate, (7.5–)12–16 × (2.5–)4–7.5(–9) cm, 1.8–3.5 times longer than wide, widest 25%–40% from the base, blade base obtuse to broadly rounded, tip tapering toward a mostly rather long but not distinctly separated acumen, margin flat; blade midrib prominent below, level to slightly impressed above; secondary veins 6 to 8 on each side of the midrib, diverging at 45°–55°, curved toward the tip, distinctly raised below, level above, tertiary venation ± scalariform, level to very slightly raised on both sides; blade indument consisting of short (< 0.2 mm) appressed hairs pointing toward the leaf tip, above

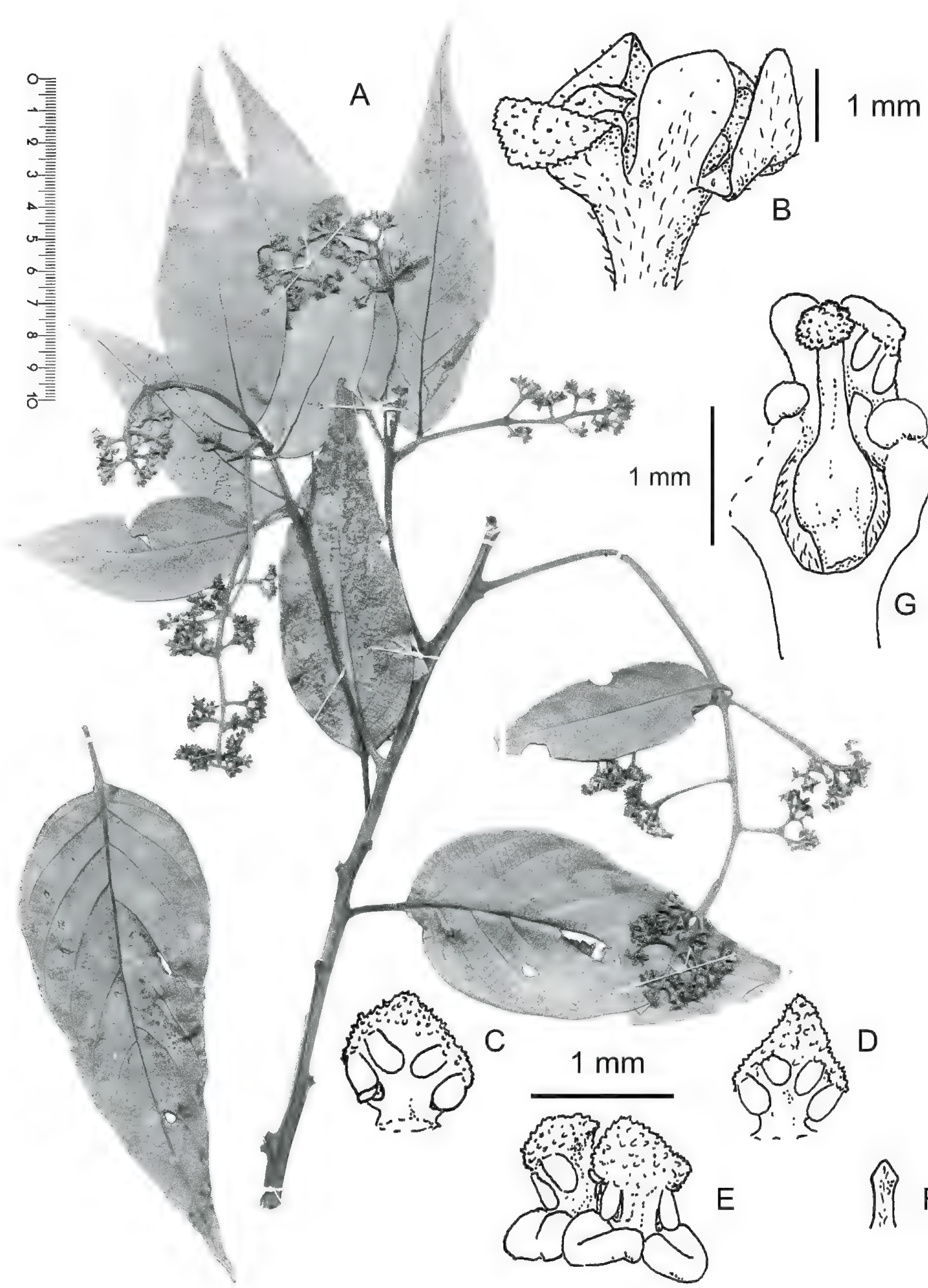

Figure 1. *Nectandra ovatocaudata* Rohwer. —A. Habit as seen in the photo of the holotype *J. Perea & V. Flores 2815* (MO). —B. Dried flower. —C. Stamen of the first androecial whorl, seen from the adaxial side. —D. Stamen of the second androecial whorl, seen from the adaxial side. —E. Two stamens of the third androecial whorl, lateral view (at left) and seen from the abaxial side (at right). —F. Staminode of the fourth androecial whorl, seen from the adaxial side. —G. Receptacle, cut open (semi-schematic), with ovary, two stamens of the third androecial whorl and a staminode evident between the ovary and the stamen on the right. Illustrations in B–G taken from the holotype.

initially moderately dense but still inconspicuous, quickly glabrescent, below initially moderately dense to dense, quickly becoming sparser and rather inconspicuous. Inflorescences thyrsoid, in the axils of distal foliage leaves, 5–11 cm long (one of them 20 cm, with frondose bracts at the first branching), 1.3–1.8(–2.3) mm thick at the base, with an indument as on the twigs throughout, distally also with a few slightly longer and more ascending hairs, peduncle 3–5.5 cm, lateral branches cymose, (2 to)4 to 6 below a terminal cluster of 3 or 4 cymes, branched 1 to 3 times; pedicels 0.6–1.5 × 0.6–0.8 mm. Flowers white (according to type label), bisexual, ca. 5–6 mm diam.; tepals elliptic, ca. 2.2–2.5 × 1.3–1.8 mm, papillose on adaxial side, outer tepals pubescent on abaxial side, inner tepals usually slightly smaller, abaxially pubescent only in the basal triangle that is not covered by the outer tepals in bud; fertile stamens 9, ca. 1 mm, tetrasporangiate, pollen sacs arranged in a shallow arc in the basal 2/3 of the anther, the apical portion sterile, papillose, filaments extremely short, indistinct, in the outer whorls abaxially adnate to the tepals, stamens of the first whorl ± ovate, ca. 1 mm wide, in the second whorl more trullate and slightly narrower, in the third whorl abaxially with a pair of glands at the base, apically obtuse to broadly rounded; staminodes (as a fourth androecial whorl) largely hidden between the glands, ca. 0.5 mm long, slightly thickened at the tip, fused with the adjacent stamens at the base; pistil ca. 2 mm, glabrous, ovary ca. 1 mm, ellipsoid, almost completely enclosed by the receptacle and the fused stamen bases; receptacle urceolate, densely pubescent inside. Fruit unknown.

Etymology. *Nectandra ovatocaudata* is named for its unusual leaf shape. The larger leaves have a more or less rounded base, as in ovate leaves, but they taper very gradually toward a rather long tip. The widest leaf of the paratype, however, has only a short acumen.

Habitat and distribution. *Nectandra ovatocaudata* is found in tropical montane forest and its degraded remnants, and possibly (according to the type label) in swamp as well. The species is so far only known from the province of San Ignacio, Cajamarca, Peru.

IUCN Red List category. Since *Nectandra ovatocaudata* is known from only two collections from a single province in Peru, its conservation status cannot be adequately assessed at this time. It is considered Data Deficient (DD), according to IUCN (2001) criteria.

Discussion. *Nectandra ovatocaudata* is a typical *Nectandra*, with anthers showing an obtuse to triangular, papillose sterile tip. It is described here with some hesitation, since many typical *Nectandra* species are linked by occasional intermediate collections (see Rohwer, 1993). Here, however, a considerable geographical distance and a habitat difference support its recognition as a separate species. Using the key from Rohwer (1993), it would most likely be identified as *N. amazonum*, a species from seasonally inundated Amazonian lowland forests, below 200 m altitude. Although the leaf shape is quite variable in *N. amazonum*, it never has such a broadly rounded leaf base as in *N. ovatocaudata*. In addition, *N. amazonum* usually has larger flowers (6.5–10 mm diam.), and its receptacle is glabrous inside. Broadly rounded leaf bases and a receptacle that is densely pubescent inside are sometimes found in the Andean *N. laurel*. In that species, however, the indument on the lower leaf surface is usually longer (0.4–0.8 mm), denser, more feltlike, and more persistent. Even in the least pubescent collections the trichomes do not show a parallel orientation, as in *N. ovatocaudata*. In addition, the leaves of *N. laurel* show a much more prominent tertiary venation, and its flowers are generally larger, usually 9–14 mm in diameter.

Paratype. PERU. **Cajamarca:** Prov. San Ignacio, Distr. Huarango, Poblado Selva Andina, 05°03′50″S, 078°43′19″W, 2378 m, 21 Aug. 2007 (fl.), *J. Perea, E. Becerra, A. Peña & J. Díaz 3607* (HBG, MO).

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Validation of Names of Fossil Fungi from Tertiary Sediments of India

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Abstract. The names of 14 species of fossil fungi are validated, two recognized by Kar, one by Rao, and 11 by Nandi et al. The repositories of their holotypes were not specified by the original describing authors, and this validating information is provided herein. All names and their validating descriptions/diagnoses are ascribed to their original authors. These new species names are: *Diporisporites giganticus* R. K. Kar, *Hypoxylonites bhubanensis* B. Nandi & S. Banerjee, *H. elsikii* B. Nandi & S. Banerjee, *H. minimus* B. Nandi & S. Banerjee, *H. neogenicus* B. Nandi & S. Banerjee, *H. subrotundus* B. Nandi & S. Banerjee, *H. thindii* B. Nandi & A. Sinha, *Kalviwadithyrites saxenae* M. R. Rao, *Lirasporis elongatus* R. K. Kar, *Spirotremesporites ellipticus* B. Nandi & S. Banerjee, *S. longiletus* B. Nandi & S. Banerjee, *S. miocenicus* B. Nandi & S. Banerjee, *S. reniformis* B. Nandi & S. Banerjee, and *S. tertiarus* B. Nandi, S. Banerjee & A. Sinha. The genus name *Kalviwadithyrites* M. R. Rao is also here validated, together with the name of its single species, *K. saxenae* M. R. Rao. The species mentioned above belong to Xylariaceae, Microthyriaceae, and Fungi Imperfecti (Amerosporae and Dictyosporae).

Key words: *Diporisporites*, Fungi Imperfecti, *Hypoxylonites*, India, *Kalviwadithyrites*, *Lirasporis*, Microthyriaceae, *Spirotremesporites*, Xylariaceae.

Encountering dispersed fungal fruiting bodies, spores, and mycelia is a common aspect of palynological investigations. Records of fossil fungi from the Indian Tertiary sediments have been published in the form of two catalogues (Saxena, 1991, 2006). During the preparation of the latter catalogue (Saxena, 2006), the author noticed the names of one genus and 14 species of fossil fungi (belonging to Xylariaceae, Microthyriaceae, and Fungi Imperfecti) that were not validly published, because the authors of these names did not specify the single herbarium or collection or institution in which the types were conserved (cf. ICBN, Art. 37.7, McNeill et al., 2006). Two of these species were described by Kar (1990) from the subsurface Miocene and Mio-Pliocene sediments of Tripura in northeastern India. The one fungal genus, viz. *Kalviwadithyrites* M. R. Rao, and its proposed type, *K. saxenae* M. R. Rao, were described by Rao (2003) from the Sindhudurg Formation (Miocene) of Maharashtra, western India. Further, Nandi et al. (2003) recorded several species of *Hypoxylonites* Elsik (1990) and *Spirotremesporites* Dueñas-Jimenez (1979) from the Cretaceous and Tertiary sediments of northeastern India. Of these, six species of *Hypoxylonites* and five species of *Spirotremesporites* were described as new but were not validly published.

All of the above-mentioned species are based on sound morphological features and are well recognizable. This is evident because their original authors compared these species with other species of the respective genus and demonstrated that each of the proposed species was different from them. These fossil fungal names are validly published below and in each case are ascribed to the original author(s), with a full and direct reference to the previously and effectively published descriptions/diagnoses and illustrations as provided by the same original author(s). The holotype of each species name, as designated by the original author(s), along with its repository, is also cited. The slides of Kar (1990) and Rao (2003) are stored in the museum of the Birbal Sahni Institute of Palaeobotany, in Lucknow, India. Bharati Nandi (pers. comm.) informed the author that her slides containing holotypes are stored in the Pteridology and Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India.

I. Diporisporites Hammen (Fungi Imperfecti, Amerosporae).

The diagnostic characters of *Diporisporites* are as follows: shape generally elongate, diporate, pores on opposite ends.

1. **Diporisporites giganticus** R. K. Kar, sp. nov. Validating diagnosis and illustrations in R. K. Kar, J. Palynol. 26: 196, pl. 8, figs. 114, 115. 1990. India. NE India, Tripura, subsurface Miocene sediment (holotype, designated by Kar [1990: pl. 8, fig. 114], based on slide no. 9681/1/9, Q44/3, deposited at Museum, Birbal Sahni Institute of Palaeobotany, Lucknow, India).

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II. Hypoxylonites Elsik (Xylariaceae).

The diagnostic characters of *Hypoxylonites* are as follows: oval to elongate, bilateral, psilate, with elongate scar, slit or furrow.

1. **Hypoxylonites bhubanensis** B. Nandi & S. Banerjee, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 58, pl. I, figs. 1, 2, text fig. 3, 1. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. I, fig. 2], based on slide no. RKSL 50/IV, coordinates 107.5/72.3, Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

2. **Hypoxylonites elsikii** B. Nandi & S. Banerjee, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 58, pl. I, figs. 5, 9, 16, 17, text fig. 3, 3. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. I, fig. 16], based on slide no. RKSL 50/IV, coordinates 105.3/14.0, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

3. **Hypoxylonites minimus** B. Nandi & S. Banerjee, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 59, pl. I, figs. 12, 21, text fig. 3, 5. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. I, fig. 12], based on slide no. RKSL 50/IV, coordinates 96.4/62.7, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

4. **Hypoxylonites neogenicus** B. Nandi & S. Banerjee, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 59–60, pl. I, figs. 13, 14, text fig. 3, 2. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. I, fig. 14], based on slide no. RKSL 50/V, coordinates 101.8/53.6, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

5. **Hypoxylonites subrotundus** B. Nandi & S. Banerjee, sp. nov. Validating description and illustration in Nandi et al., Acta Palaeontol. Sin. 42(1): 60, pl. I, fig. 19, text fig. 3, 4. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. I, fig. 19], based on slide no. RKSL 50/V, coordinates 101.8/53.6, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

6. **Hypoxylonites thindii** B. Nandi & A. Sinha, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 60, pl. II, figs. 3, 14, 15, text fig. 3, 6. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. II, fig. 3], based on slide no. RKSL 50/IV, coordinates 97.5/57.2, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

III. Kalviwadithyrites M. R. Rao (Microthyriaceae).

The diagnostic characters of *Kalviwadithyrites* are as follows: cleistothecium subcircular to circular in shape, dimidiate, non-ostiolate. Two types of cells present, pores absent. No hyphae present. Marginal cells rectangular to polygonal in shape, larger in size, covering outer part; central cells' thickness 2- or 3-layered, squarish and isodiametric.

Rao (2003) compared *Kalviwadithyrites* with *Phragmothyrites* Edwards, *Microthyriacites* Cookson, *Parmathyrites* Jain & Gupta, *Siwalikiathyrites* Saxena & Singh, and *Ratnagiriathyrites* Saxena & Misra, and demonstrated that *Kalviwadithyrites* can be differentiated from the other genera in having two types of nonporate cells.

Kalviwadithyrites M. R. Rao, gen. nov.

Validating diagnosis in Rao, Palaeobotanist 52(1–3): 118. 2003. TYPE: *Kalviwadithyrites saxenae* M. R. Rao, sp. nov., monotypic.

The generic name *Kalviwadithyrites* M. R. Rao was not validly published because the species name indicating its type was not validly published (McNeill et al., 2006: Art. 10.1 and 37.7). The type, *K. saxenae*, is validated by providing the missing information on the repository of the holotype.

1. **Kalviwadithyrites saxenae** M. R. Rao, gen. et sp. nov.

Validating description and illustrations in Rao, Palaeobotanist 52(1–3): 118, pl. 1.1–1.3, fig. 2. 2003. TYPE: India. Maharashtra: Sindhudurg Formation, Miocene sediment (holotype, designated by Rao [2003: pl. 1.1], based on slide no. BSIP 12689, deposited at Museum, Birbal Sahni Institute of Palaeobotany, Lucknow, India).

IV. Lirasporis R. Potonié & Sah (Fungi Imperfecti, Dictyosporae).

The diagnostic characters of *Lirasporis* are as follows: fungal bodies oval-elliptical with equal or unequal, broad, generally notched ends. Mycelia, long, septate, ± parallel to one another, extending from one end to the other; wall generally laevigate, sometimes granulose.

1. **Lirasporis elongatus** R. K. Kar, sp. nov. Validating diagnosis and illustrations in Kar, J. Palynol. 26: 196, pl. 8, figs. 116, 117. 1990. TYPE: India. NE India, Tripura, Rokhia borehole, subsurface Miocene sediment (holotype, designated by Kar [1990: pl. 8, fig. 117], based on slide no. 9684/4/3, R41/3, deposited at Museum, Birbal Sahni Institute of Palaeobotany, Lucknow, India).

V. Spirotremesporites Dueñas-Jimenez (Xylariaceae).

The diagnostic characters of *Spirotremesporites* are as follows: psilate, aseptate, elongate elliptical to oval, aperture in the form of a single furrow at an angle to the axis of the spore, straight or curved to S-shaped or sigmoidal in outline, or spiral around the spore axis.

1. **Spirotremesporites ellipticus** B. Nandi & S. Banerjee, sp. nov. Validating description and illustration in Nandi et al., Acta Palaeontol. Sin. 42(1): 60, pl. II, fig. 9, text fig. 3, 8. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. II, fig. 9], based on slide no. RKSL 50/I, coordinates 104.5/61.6, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

2. **Spirotremesporites longiletus** B. Nandi & S. Banerjee, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 60 & 61, pl. II, figs. 10, 11, 17, text fig. 3, 7. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. II, fig. 10], based on slide no. RKSL 50/V, coordinates 100.4/25.8, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

3. **Spirotremesporites miocenicus** B. Nandi & S. Banerjee, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 61, pl. II, figs. 8, 13. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. II, fig. 8], based on slide no. RKSL 50/IV, coordinates 111.5/17.4, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

4. **Spirotremesporites reniformis** B. Nandi & S. Banerjee, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 61–62, pl. II, figs. 4, 6, text fig. 3, 9. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. II, fig. 4], based on slide no. RKSL 50/IV, coordinates 110.5/72.5, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

5. **Spirotremesporites tertiarus** B. Nandi, S. Banerjee & A. Sinha, sp. nov. Validating description and illustrations in Nandi et al., Acta Palaeontol. Sin. 42(1): 62, pl. II, figs. 5, 18, text fig. 3, 10. 2003. TYPE: India. NE India, Mizoram, Renkte Kawn–Sherlui Rd., Late Tertiary sediment (holotype, designated by Nandi et al. [2003: pl. II, fig. 5], slide no. RKSK 50/IV, coordinates 108.3/58.6, deposited at Pteridology & Palynology Laboratory, Department of Botany, Kalyani University, Kalyani, India).

Nandi et al. (2003: 60) placed her species described for *Spirotremesporites* under "*Spirotremesporites* Elsik," whereas the genus was effectively and validly published by Dueñas-Jimenez (1979). Elsik (1990) later emended the generic diagnosis to include spores having only a single furrow in contrast to the original diagnosis where spores possessing one or several spiraling furrows were included. Therefore, the citation of Elsik (1990) as attributed to *Spirotremesporites* (and also of its type: *S. simplex*

Dueñas-Jimenez, 1979) by Nandi et al. (2003) is an inadvertent error of citation and her species, validated above, were originally published as *Spirotremesporites* Dueñas-Jimenez (1979).

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A New Species of *Leymus* (Poaceae, Triticeae) from China

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ABSTRACT. A new species of *Leymus* Hochst. (Poaceae, Triticeae) from Inner Mongolia, China, *L. pubens* H. X. Xiao, is described, illustrated, and compared with its closest relatives. This species was initially identified as *L. chinensis* (Trin.) Tzvelev, but the upper surfaces of its leaf blades are spinulose, and the internode below the spike, upper half of the rachis, rachilla, and lemmas are sparsely puberulent. A key is provided for *L. pubens* and closely related species of *Leymus*. The identification of the new species is also supported by nuclear ribosomal ITS and chloroplast *trnL-F* sequence analyses.

Key words: China, Inner Mongolia, ITS, IUCN Red List, *Leymus*, Poaceae, Triticeae, *trnL-F*.

Leymus Hochst. is an important perennial genus in the wheat tribe (Poaceae, Triticeae). Hochstetter (1848) separated it from traditional *Elymus* L., with *L. arenarius* (L.) Hochst. as the type species. *Leymus* includes ca. 63 species and 19 subspecies that are distributed in diverse ecological habitats across temperate regions of Eurasia, North America, and South America, also extending into subtropical and tropical alpine regions (Yen et al., 2009). *Leymus* species grow in saline or alkaline soils, from dry or semi-dry areas, and are well adapted to cold and dry conditions.

During fieldwork on the Songnen steppe in July 2009, several interesting plants initially identified as *Leymus chinensis* (Trin.) Tzvelev were collected. At first sight, the taxon appeared similar to *L. chinensis* yellow-green type (yellow-green leaf blades). However, this collection exhibited several characters distinct from typical *L. chinensis*. On subsequent visits to this and adjacent localities in June of 2010, additional material was collected, including fertile spikes. Preliminary work at HNWP and NENU suggested a distinctive and new species, which is presented in this paper. In addition, based on taxonomic literature and expert specialists (Cai, 2000; Zhi & Teng, 2005; Chen & Zhu, 2006; Yen et al., 2009) in the field, our material differed from any currently recognized species of *Leymus*. ITS and chloroplast *trnL-F* sequences analysis further supported the taxon's recognition as a new species. Sequences from the nuclear ribosomal ITS and chloroplast *trnL-F* genic region were used, based on their relevance for phylogenetic reconstruction in angiosperms at lower taxonomic levels (Baldwin et al., 1995; Hodkinson et al., 2007).

MATERIALS AND METHODS

MORPHOLOGICAL ANALYSIS

Morphological and morphometrical studies were carried out on specimens, with comparisons made to the materials kept at HNWP and NENU, and also to the taxonomic literature such as *Flora Europaea* (Melderis, 1980), *Flora Qinghaiica* (Cai, 1999), *Flora Xinjiangensis* (Cui, 1996), and *Flora Intramongolica* (Yang, 1994). At least 30 measurements on fresh material were performed on each morphological variable by using a stereoscopic microscope (Motic K-400L; Motic, Xiamen, China) with a digital camera. The following parameters were selected to describe the morphology of the studied specimens: ligule lengths, leaf blades, rachis internodes, spike morphology, pubescence, glume and lemma shapes, etc. Microphotographs were taken with a Moticam 2506 camera (Motic) and then processed with Image Pro-Plus software version 4.5 (Media Cybernetics, Inc., Silver Springs, Maryland, U.S.A.).

PLANT MATERIAL

Fifteen accessions of *Leymus*, including the new species, were sequenced for nuclear ribosomal ITS and chloroplast *trnL-F* in the present study, with 12 accessions identified as the *L. chinensis* gray-green type (six accessions) and *L. chinensis* yellow-green type (six accessions). Each taxon was collected from three different regions across the distributional range of the suspected new species, according to soil type. The sequences generated in this study were analyzed together with 12 related Triticeae using *Bromus catharticus* Vahl as the outgroup, based on its use as an outgroup by previous phylogenetic studies of the Poaceae (e.g., Bouchenak-Khelladi et al., 2008; Sha et al., 2008). GenBank accession numbers and voucher details are listed in Table 1.

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DNA EXTRACTION, POLYMERASE CHAIN REACTION AMPLIFICATION, AND SEQUENCING

Genomic DNA was extracted from ca. 50 mg of fresh or 10 mg silica-dried leaf materials using the E.Z.N.A. Plant DNA Mini Kit (Omega Bio-tek, Inc., Norcross, Georgia, U.S.A.), according to the manufacturer's instructions. The entire ITS region (ITS-1, 5.8S ribosomal DNA, and ITS-2) was amplified by using primers ITS-1 and ITS-4 (White et al., 1990), while the chloroplast *trnL-F* was amplified by using primers *c* and *f* (Taberlet et al., 1991). An Applied Biosystems (Carlsbad, California, U.S.A.) 2720 PCR System was used, with cycling as follows: 94° for 5 min., 35 cycles at 94° for 1 min., 53° for 1 min., 72° for 1 min., followed by 72° for 10 min. The cloned PCR products were sequenced in both directions by Sangon Co., Ltd. (Shanghai, China), and all the sequences used in the phylogenetic analysis were derived from at least five independent clones to examine whether there were multiple copies within individuals (intra-individual polymorphisms). Forward and reverse sequences of each sample were manually edited and combined into a single consensus sequence.

PHYLOGENETIC ANALYSIS

Sequences of the nuclear ribosomal ITS and chloroplast *trnL-F* were aligned with ClustalX version 2 (Larkin et al., 2007) and adjusted manually. Phylogenetic trees were constructed by using the neighbor-joining algorithms available in MEGA version 3.1 (Kumar et al., 2004). The topology of the tree was evaluated by using Kimura's two-parameter calculation model. Gaps were coded as missing data with the pairwise deletion option, and for testing the robustness of the clades, a bootstrap analysis was performed with 1000 replicates (Liu et al., 2008).

RESULTS

MORPHOLOGY

The new species was initially identified as *Leymus chinensis*, based on its similar, yellowish green leaf blades. However, the new species may be contrasted by its spinulate adaxial leaf blades and the sparse puberulence of the upper half of the rachis and rachilla, as well as the internode immediately below the spike and lemmas. In contrast, adaxial leaf blades of *L. chinensis* are puberulent, and the rachis, rachilla, and internode immediately below the spike as well as the lemmas are glabrous (Fig. 1). The new species also resembles *L. karelinii* (Turcz.) Tzvelev and *L. angustus* (Trin.) Pilg. in that the lemmas and the upper portion of the rachis are dorsally puberulent. The new species differs from both taxa by its creeping rhizomes and spikelets with four to eight florets, while *L. karelinii* and *L. angustus* have only downward rhizomes and spikelets that are 2- to 3-flowered.

PHYLOGENETIC ANALYSIS

In the neighbor-joining dendrogram, 14 *Leymus* accessions resolved into two principal groups (Fig. 2). All representatives of the new species and all 12 for *L. chinensis* were in group A, which was composed of four subclades, with one including the *L. chinensis–L. pubens* clade. Within this subclade, 15 accessions of *L. chinensis* and *L. pubens* comprised monophyletic groups, with 99% bootstrap support, respectively. Bootstrap values higher than 70% would indicate these clades as reliable. Each individual accession in the two groups was gathered from different distributional locales. The *L. chinensis–L. pubens* clade resolved as sister to a clade including *L. arenarius*, *L. secalinus* (Georgi) Tzvelev, *L. pseudoracemosus* C. Yen & J. L. Yang, *L. mollis* (Trin.) Pilg., *L. karelinii* (Turcz.) Tzvelev, *L. angustus* (Trin.) Pilg., *L. akmolinensis* (Drobow) Tzvelev, and *L. racemosus* (Lam.) Tzvelev, all morphologically distinct from species in the sister clade. The three accessions of *L. pubens* showed nucleotide differences in the ITS region (five substitutions) and chloroplast *trnL-F* (14 substitutions), with respect to *L. chinensis*. These molecular differences further support the taxonomic separation of the two species.

Leymus pubens H. X. Xiao, sp. nov. TYPE: China. Inner Mongolia: Tongliao, Liangzhijian, on sandy places, 44°26.633′N, 122°02.581′E, 165 m, 10 June 2010, *H. X. Xiao 40003* (holotype, NENU; isotypes, NENU, National History Museum of Jilin). Figure 3.

Haec species *Leymo chinensi* (Trin.) Tzvelev similis, sed ab ao lamina foliari adaxialiter spinulosa atque rhachidis internodio infra spicam ac dimidio superiore sicut rhachilla lemmatibusque omnibus parce puberulis distinguitur.

Perennial herbs, yellow-green, with long rhizomes creeping and downward; culms solitary or caespitose, 30–90 cm tall, with 3 to 4 nodes. Leaf sheaths glabrous, the basal sheaths persistent, sometimes disintegrating into fibers; ligules papery, 1.5–2(2.5) mm long, obtuse; leaf blades involute, 5–25 × 3–5 cm, upper surfaces and the margins spinulate, lower surfaces glabrous. Spikes lax, 7–20 cm; rachis internodes generally 5–11 mm, or basal ones up to 30 mm, dorsally puberulent in upper portion, margins ciliate. Spikelets usually paired, rarely one at each

Table 1. Sources of plant material used in this study. The accession numbers correspond to the numbers used in Figure 2. One asterisk denotes that the voucher specimen was deposited at the herbarium of the School of Life Sciences, Northeast Normal University, China (NENU). Two asterisks indicate that the sequences were taken from GenBank (<http://www.ncbi.nlm.nih.gov/genbank/>). NA refers to data not available. The soil type classification is from previous studies (Li, 2001; Qiu, 2008).

Accession number	Taxon	Voucher	GenBank accession number	
			ITS	*trnL-F*
1	*Leymus chinensis* (Trin.) Tzvelev (yellow-green type)	China. Inner Mongolia: Tumuji, Kastanozems soil, 159 m, 11 June 2010, *H. X. Xiao 40001**	HQ391341	JQ627774
2	*L. chinensis* (gray-green type)	China. Inner Mongolia: Tumuji, Kastanozems soil, 159 m, 11 June 2010, *H. X. Xiao 40002**	HQ391342	JQ627775
3	*L. pubens* H. X. Xiao	China. Inner Mongolia: Liangzhijian, Sandy soil, 165 m, 10 June 2010, *H. X. Xiao 40003**	HQ391343	JQ627786
4	*L. chinensis* (gray-green type)	China. Inner Mongolia: Liangzhijian, Sandy soil, 165 m, 10 June 2010, *H. X. Xiao 40004**	HQ391344	JQ627776
5	*L. pubens*	China. Jilin: Changling, Saline-alkali soil, 159 m, 9 June 2010, *H. X. Xiao 40005**	HQ391345	JQ627787
6	*L. chinensis* (gray-green type)	China. Jilin: Changling, Saline-alkali soil, 159 m, 9 June 2010, *H. X. Xiao 40006**	HQ391346	JQ627777
7	*L. chinensis* (yellow-green type)	China. Jilin: Zhenlai, Saline-alkali soil, 146 m, 9 June 2010, *H. X. Xiao 40007**	HQ391347	JQ627778
8	*L. chinensis* (gray-green type)	China. Jilin: Leshan, Black soil, 247 m, 13 June 2010, *H. X. Xiao 40008**	HQ391348	JQ627779
9	*L. pubens*	China. Jilin: Wushiwu, Saline-alkali soil, 146 m, 9 June 2010, *H. X. Xiao 40009**	HQ391349	JQ627788
10	*L. chinensis* (yellow-green type)	China. Jilin: Qianan, Saline-alkali soil, 151 m, 8 June 2010, *H. X. Xiao 40010**	HQ391350	JQ627780
11	*L. chinensis* (yellow-green type)	China. Jilin: Qianguo, Saline-alkali soil, 148 m, 8 June 2010, *H. X. Xiao 40011**	HQ391351	JQ627781
12	*L. chinensis* (gray-green type)	China. Inner Mongolia: Tumuji, Saline-alkali soil, 159 m, 11 June 2010, *H. X. Xiao 40012**	HQ391352	JQ627782
13	*L. chinensis* (yellow-green type)	China. Jilin: Qianguo, Saline-alkali soil, 140 m, 8 June 2010, *H. X. Xiao 40013**	HQ391353	JQ627783
14	*L. chinensis* (gray-green type)	China. Jilin: Qianguo, Saline-alkali soil, 140 m, 8 June 2010, *H. X. Xiao 40014**	HQ391354	JQ627784
15	*L. chinensis* (yellow-green type)	China. Inner Mongolia: Tumuji, Saline-alkali soil, 159 m, 11 June 2010, *H. X. Xiao 40015**	HQ391355	JQ627785
16	*L. akmolinensis* (Drobow) Tzvelev	NA	EF581913**	EF581897**
17	*L. angustus* (Trin.) Pilg.	NA	EF581920**	EF581909**
18	*L. secalinus* (Georgi) Tzvelev	NA	EF581975**	EF581904**
19	*L. ambiguus* (Vasey & Scribn.) D. R. Dewey	NA	EF581916**	EF581905**
20	*L. cinereus* (Scribn. & Merr.) Á. Löve	NA	EF581946**	EF581899**
21	*L. racemosus* (Lam.) Tzvelev	NA	EF581968**	EF581903**
22	*L. karelinii* (Turcz.) Tzvelev	NA	EF581960**	EF581907**
23	*L. triticoides* (Buckley) Pilg.	NA	EF485567**	EU366404**
24	*L. erianthus* (Phil.) Dubcovs.	NA	EF601993**	EU366398**
25	*L. pseudoracemosus* C. Yen & J. L. Yang	NA	EF602016**	EU366399**
26	*L. arenarius* (L.) Hochst.	NA	EF581934**	EF581906**
27	*L. mollis* (Trin.) Pilg.	NA	EF581964**	EF581902**
28	*Bromus catharticus* Vahl	NA	AF521898**	EU036184**

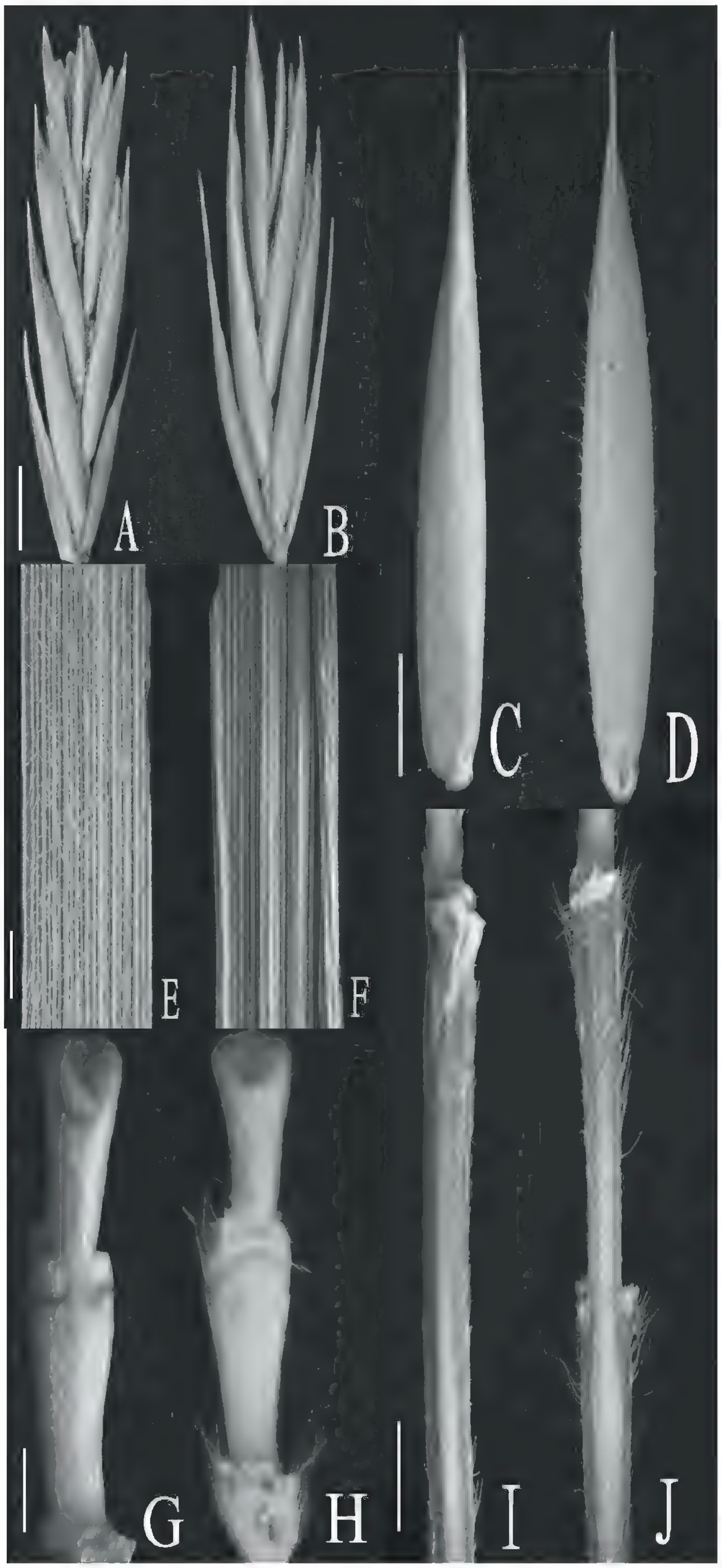

Figure 1. Morphological comparison of the two species of *Leymus* Hochst. A, C, E, G, I. *Leymus chinensis* (Trin.) Tzvelev; B, D, F, H, J. *Leymus pubens* H. X. Xiao. —A, B. Spikelets. —C, D. Glumes. —E, F. Upper surfaces of leaf blade. —G, H. Rachillas. —I, J. Rachises. Scale bars: A, B, E–H = 18 mm; C, D = 9 mm; I, J = 15 mm. Microphotographs taken from *H. X. Xiao 40001* and *H. X. Xiao 40005* (NENU).

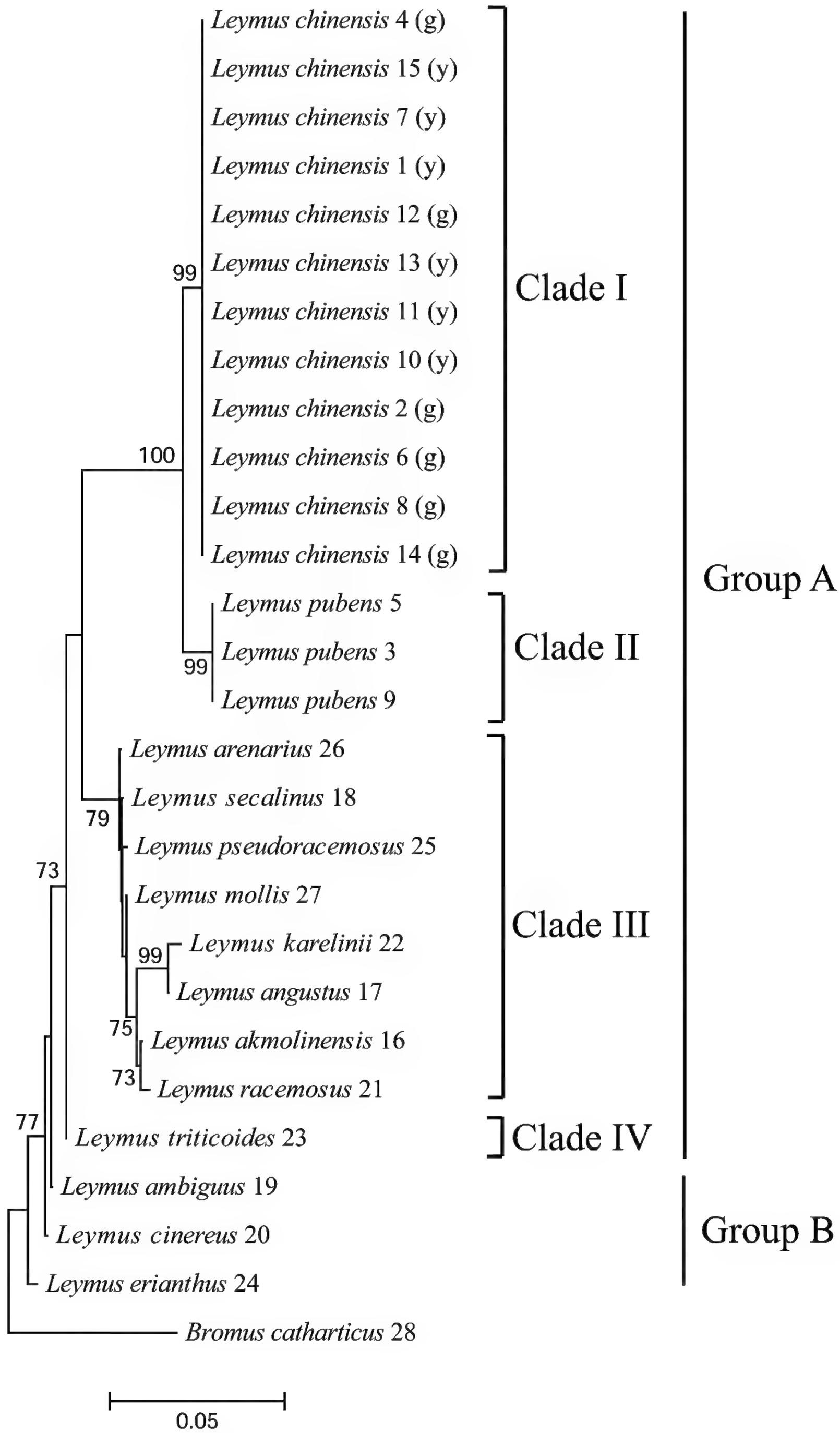

Figure 2. Neighbor-joining tree based on the sequences of nuclear ITS and chloroplast *trnL-F* genic region for *Leymus pubens* H. X. Xiao and related *Leymus* species. Numbers at nodes are bootstrap percentages greater than or equal to 50%. The letter "g" inside parentheses refers to *L. chinensis* (Trin.) Tzvelev gray-green type; the "y" within parentheses refers to *L. chinensis* yellow-green type. Numbers refer to the accessions in Table 1.

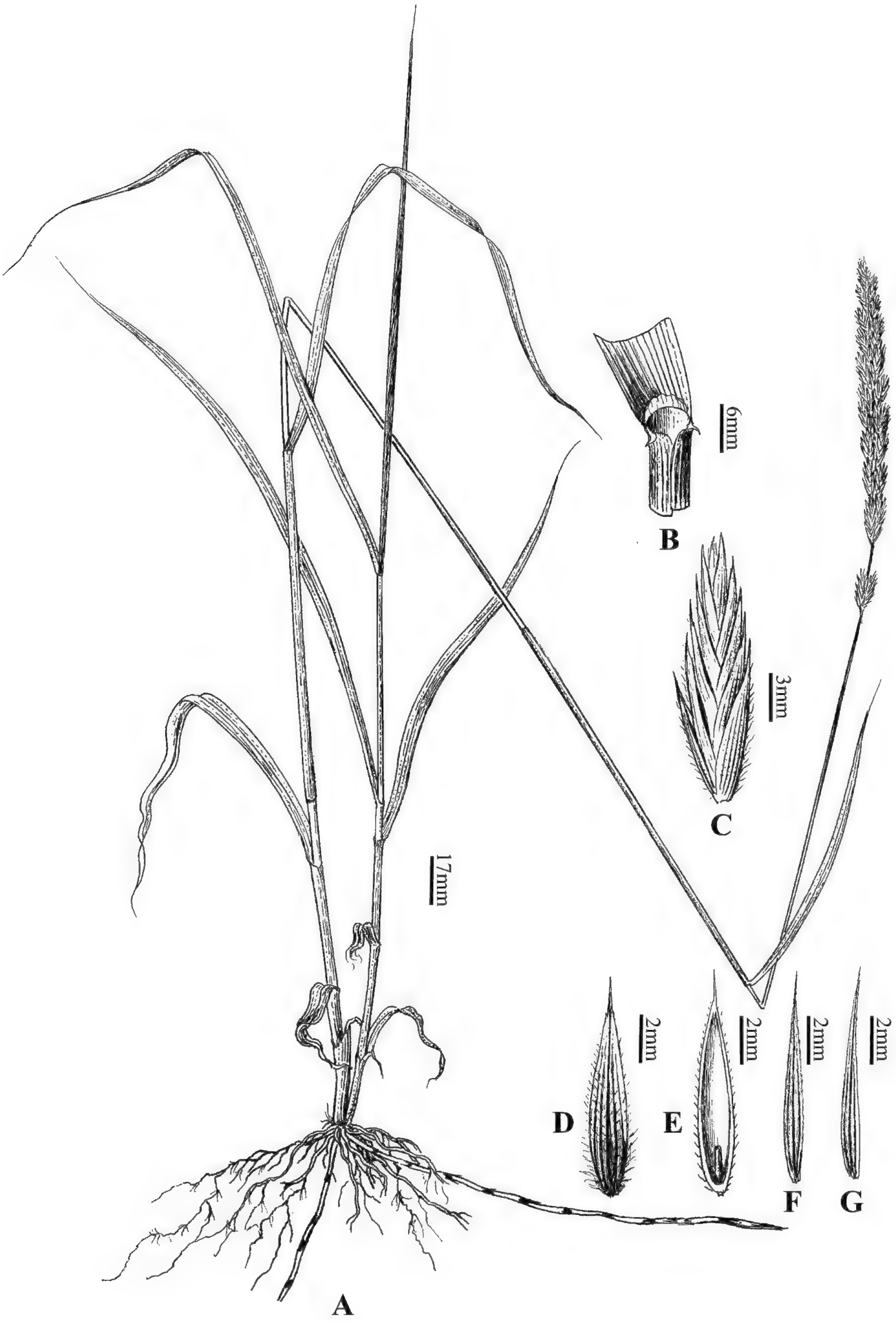

Figure 3. *Leymus pubens* H. X. Xiao. —A. Fertile plant. —B. Junction of sheath and blade to show ligule. —C. Spikelet. —D. Dorsal view of the first floret. —E. Ventral view of the first floret. —F. Lower glume. —G. Upper glume. Drawn by Wu Zhi-xue from the type *H. X. Xiao 40003* (NENU).

node of the rachis, or singly in upper half, 4- to 8-flowered, 10–20 mm long; rachilla internodes 1–3 mm, sparsely puberulent; glumes lanceolate, 1- or 3-nerved, ciliate along the margins, tip with a 2–3(4) mm awn at the apex, first glume 6.5–9.5 mm (excluding awn), second glume 7.5–11 mm; lemmas lanceolate, obscurely 5-nerved, rarely 7-nerved, sparsely puberulent on the back, membranous along the margins, with a short mucro 0.5–2 mm; paleae nearly equal to lemma, bifid, spinulose along the keels; anthers yellowish cream, rarely purplish, ca. 4 mm long; ovary cuneate, densely puberulent, with the trichomes 0.5–0.8 mm long on upper half.

Distribution and habitat. *Leymus pubens* is currently known only from the eastern portion of Inner Mongolia and western Jilin Province in China. The new taxon was observed to grow at the margins of woodlands, grasslands, and roadsides at altitudes from 146 to 165 m on saline-alkali and sandy soil.

IUCN Red List category. *Leymus pubens* is accessed here as Least Concern (LC), according to the IUCN Red List Criteria (IUCN, 2001), based on its relatively extensive distribution. This species is now known only from three different localities of China, spanning a distributional area of approximately 24,000 km^2. In the area called Changling, this species is relatively more common and the populations seem to have more individuals. However, there is no precise information for the size of the populations, due to the fact that *L. pubens* at first sight is similar to *L. chinensis*, which is a common grass broadly distributed across the Songnen steppe and extending into Inner Mongolia.

Phenology. *Leymus pubens* was observed to flower in May and June, with fruiting in July and August.

Etymology. The specific epithet *pubens* refers to the sparse pubescence on the upper rachis, rachilla, and the stem internode immediately below the spike as well as on the lemmas.

Key to Species Closely Related to *Leymus pubens* in China

1a. Lemmas and upper portion of rachis dorsally puberulent.
  2a. Spikelets with 2 or 3 florets, plants with only rhizomes vertically oriented downward.
    3a. Lower part of glumes broadly covering the base of the lemma ..... *L. karelinii*
    3b. Lower part of glumes narrow, not covering the base of the lemma *L. angustus*
  2b. Spikelets with 4 to 8 florets, plants with long rhizomes creeping horizontally and also vertically ..... *L. pubens*

1b. Lemmas and upper portion of rachis glabrous ..... *L. chinensis*

Paratypes. CHINA. **Jilin:** Songyuan, Changling, in thick grass on slopes, 159 m, 9 June 2010, *H. X. Xiao 40005* (NENU); Songyuan, Wushiwu, 146 m, 9 June 2010, *H. X. Xiao 40009* (NENU).

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Agave temacapulinensis (Agavaceae), a New Ditepalous Species from the Los Altos Region, Jalisco, Mexico

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Abstract. *Agave temacapulinensis* A. Vázquez & Cházaro (Agavaceae) is described and illustrated from Jalisco, Mexico. The new species belongs to *Agave* L. subg. *Agave* and is a member of the Ditepalae group, sensu Gentry. It is related to *A. wocomahi* Gentry in terms of its rosette size, solitary habit in most cases, the smooth texture of the leaves, the red-tipped dimorphic tepals, and the deep floral tube. *Agave temacapulinensis* differs from *A. wocomahi* in having light gray, glaucous rosettes (vs. dark green to glaucous green); short acuminate leaves (vs. long acuminate); crenate margins (vs. straight to undulate) with smaller marginal teeth (8–10 mm vs. 10–20 mm); larger panicles (5.5–6.5 m vs. 3–5 m) with more lateral branches (16 to 18 vs. 8 to 15); and smaller seeds (5–6 × 3–4 mm vs. 7 × 4.5–5 mm).

Resumen. Una nueva especie, *Agave temacapulinensis* A. Vázquez & Cházaro (Agavaceae), es descrita e ilustrada de Jalisco, Mexico. Pertenece a *Agave* L. subg. *Agave* y corresponde al grupo Ditepalae sensu Gentry. La especie está relacionada con *A. wocomahi* Gentry en términos de tamaño de roseta, hábito no surculoso en la mayoría de los casos, textura suave de las hojas, tépalos dimórficos con puntas rojizas y tubo floral profundo, pero difiere de ésta ultima por poseer rosetas de color glauco-gris claro (vs. verde oscuro-verde glauco); hojas cortamente acuminadas (vs. largamente acuminadas); márgenes crenados (vs. rectos a ondulados); con dientes más pequeños (8–10 mm vs. 10–20 mm); panículas más grandes (5.5–6.5 m vs. 3–5 m) con más ramas laterales (16 a 18 vs. 8 a 15); y semillas más pequeñas (5–6 × 3–4 mm vs. 7 × 4.5–5 mm).

Key words: *Agave*, Ditepalae, IUCN Red List, Jalisco, maguey blanco, Temacapulín, western Mexico.

Western Mexico is the richest center of diversity of the genus *Agave* L., with 37 species (Vázquez-García et al., 2007). In North America the most species-rich regions are in Mexico, specifically in the states of Oaxaca with ca. 30 species (García-Mendoza, 2004), Jalisco with 28 species (Vázquez-García et al., 2007), and Durango with 27 species (González-Elizondo et al., 2009).

Two species of *Agave* are native to the Río Verde canyon at the El Zapotillo dam project area, both from the Cañadas de Obregón and Mexticacán municipalities in the Los Altos region of Jalisco. *Agave angustifolia* Haw. is a wide-ranging century plant from Mexico to Costa Rica, confined to volcanic, basaltic rocks. The second, an undescribed species, is confined to calcareous outcrops at the ecotones between the *Juniperus* L. forest, thorn forest, and *Taxodium* Rich. gallery forest. Initial observations on the vegetative populations of this undescribed *Agave* were recorded by Ingeniero Oscar Valencia at Acasico, Mpio. Mexticacán, in 2009 (Miguel Cházaro, pers. comm.). On 5 May 2010, flowering specimens collected in the vicinity of Palmarejo, Mpio. Cañadas de Obregón (*Vázquez-García & Cházaro 9070*, IBUG, MEXU), revealed its medium-sized panicles with dimorphic tepals, allow-

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ing its placement in *Agave* subg. *Agave* as a distinct new species of group Ditepalae sensu Gentry.

Agave temacapulinensis A. Vázquez & Cházaro, sp. nov. TYPE: Mexico. Jalisco: Cañadas de Obregón, Bajío de Temacapulín, camino hacia Palmarejo, 1670 m, 10 June 2011 (fl., cult. at Vázquez-García's home), *Vázquez-García with Cházaro 9092* (holotype, IBUG; isotypes, MEXU, MICH, MO). Figure 1.

Species nova *Agave wocomahi* Gentry similis, sed ab ea foliis glauco-griseis (vs. atroviridibus vel glaucis) breviter (vs. longe) acuminatis margine crenato (vs. recto vel undulato) dentibus minoribus (8–10 vs. 10–20 mm longis), panicula majore (5.5–6.5 vs. 3–5 m alta) ramis lateralibus numerosioribus (16 ad 18 vs. 8 ad 15) et semina minoribus (5–6 × 3–4 vs. ca. 7 × 4.5–5 mm) differt.

Rosettes 80–115 × 172 cm, open, closed or compact, single to occasionally surculose, glaucous to light gray, with 20 to 25 leaves. Leaves 55–90 × 10–20 cm, ovate to lanceolate, well armed, firm and smooth; margin crenate; marginal teeth 8–10 × 7 mm, variously flexed, usually upward and born from broad bases, 15–21 mm apart from each other at mid-leaf, 12–29 mm apart distally, closely dentate (6–10 mm apart) proximally; apical spine 35–45 × 9 mm, flexuous, black to bluish gray, channeled and long-decurrent. Inflorescence an open panicle, stalk 5–6.5 m tall, 17 cm diam. at the base; with 16 to 18 lateral branches in upper 2/5 of stalk, the lateral flowering branches (composite umbels) 20–22 cm long (including the flowers) × 16–17 cm wide, reddish to yellowish green at anthesis (the lateral fruiting branches 44–49 × 38–40 cm), the bracts 20 × 3 cm, triangular, persistent, mostly reflexed, scabrous, 4–11 cm apart. Flowers 50 to 70 per lateral branch (composite umbel), 60–71 × 12 mm, reddish at the tip in bud and bright yellow at anthesis. Floral tube 9–15 × 8–9 mm, equal to or longer than tepals; tepals dimorphic, drying leathery, persisting erect, the outer tepal lobes 10–15 × 5–6 mm, the apices red, corneous, the inner tepal lobes 12–13 mm long, with white indumentum (puberulent) and galeate at apex; thinner at the margins and a prominent longitudinal central keel abaxially, along almost the entire tepal lobe, except at the apex; stamens with filaments inserted unequally in mid-tube, those of the outer tepals inserted 1 mm higher, at 10 mm above the receptacle, yellow; anthers 21 × 2.5 mm, linear, yellow; ovary 17 × 5 mm, the neck 7 × 3 mm, style slender, yellow, the stigma clavate, trilobate and glandular, longer than the stamens post-anthesally. Fruit a capsule 40–51 × 14–18 mm, oblongoid to obovoid, stipes 2–8 mm, carpels 40–51 × 13–16 mm; seeds 5–6 × 3–4 mm, subcircular to semicircular or triangular, black, shiny, and wingless.

Distribution and ecology. *Agave temacapulinensis* has only been found in the Río Verde drainage at the municipalities of Cañadas de Obregón and Mexticacán; therefore, it appears endemic to the state of Jalisco. *Agave temacapulinensis* grows in calcareous outcrops, at ecotones between the *Juniperus*, thorn, and *Taxodium* gallery forests, at elevations of 1600–1700 m. Associated species include *J. coahuilensis* (Martínez) Gaussen (Cupressaceae), *Prosopis laevigata* (Humb. & Bonpl. ex. Willd.) M. C. Johnst. (Fabaceae), *Yucca australis* (Engelm.) Trel. (Agavaceae), *Taxodium mucronatum* Ten. (Taxodiaceae), *Vachellia schaffneri* (S. Watson) Seigler & Ebinger (Mimosaceae), *Stenocereus queretaroensis* (F. A. C. Weber) Buxb., *Opuntia jaliscana* Bravo, *Mammillaria sempervivi* DC., *M. densispina* (J. M. Coult.) Orcutt (all Cactaceae), and *Lobelia laxiflora* Kunth (Campanulaceae). In the municipality of Jalostotitlán, a few individuals of *A. temacapulinensis* were found growing in a backyard, but none occurred as a wild population there.

The deep floral tube of *Agave temacapulinensis* holds large amounts of nectar. The flowers were heavily visited by four different species of hummingbirds from 7:30 AM to 9:30 AM and less frequently during the rest of the day. Usually only one individual hummingbird visited a flower at a time. The flowers were also visited by two or more individuals of bats from 8 PM to 11 PM. The tepals of this species are erect and become firm and leathery, perhaps to protect the nectar or to provide a platform for bats to hold onto. However, this assumption is yet to be tested.

Phenology. *Agave temacapulinensis* was observed in flower from May to June; fruiting began in June.

Etymology. The species is named after the village Temacapulín, a small town that will be severely impacted by the El Zapotillo dam project.

Ethnobotany. *Agave temacapulinensis* is locally known as maguey blanco at the Mexticacán municipality (Vázquez-García, pers. obs.), where it is used to relieve internal pain from contusions and as an anti-inflammatory alternative. The leaves of *A. temacapulinensis* are used to envelop fish in cooking.

IUCN Red List category. The habitat of *Agave temacapulinensis* is heavily degraded, with the vegetation cover mostly depleted for agricultural and livestock expansion. However, a greater threat

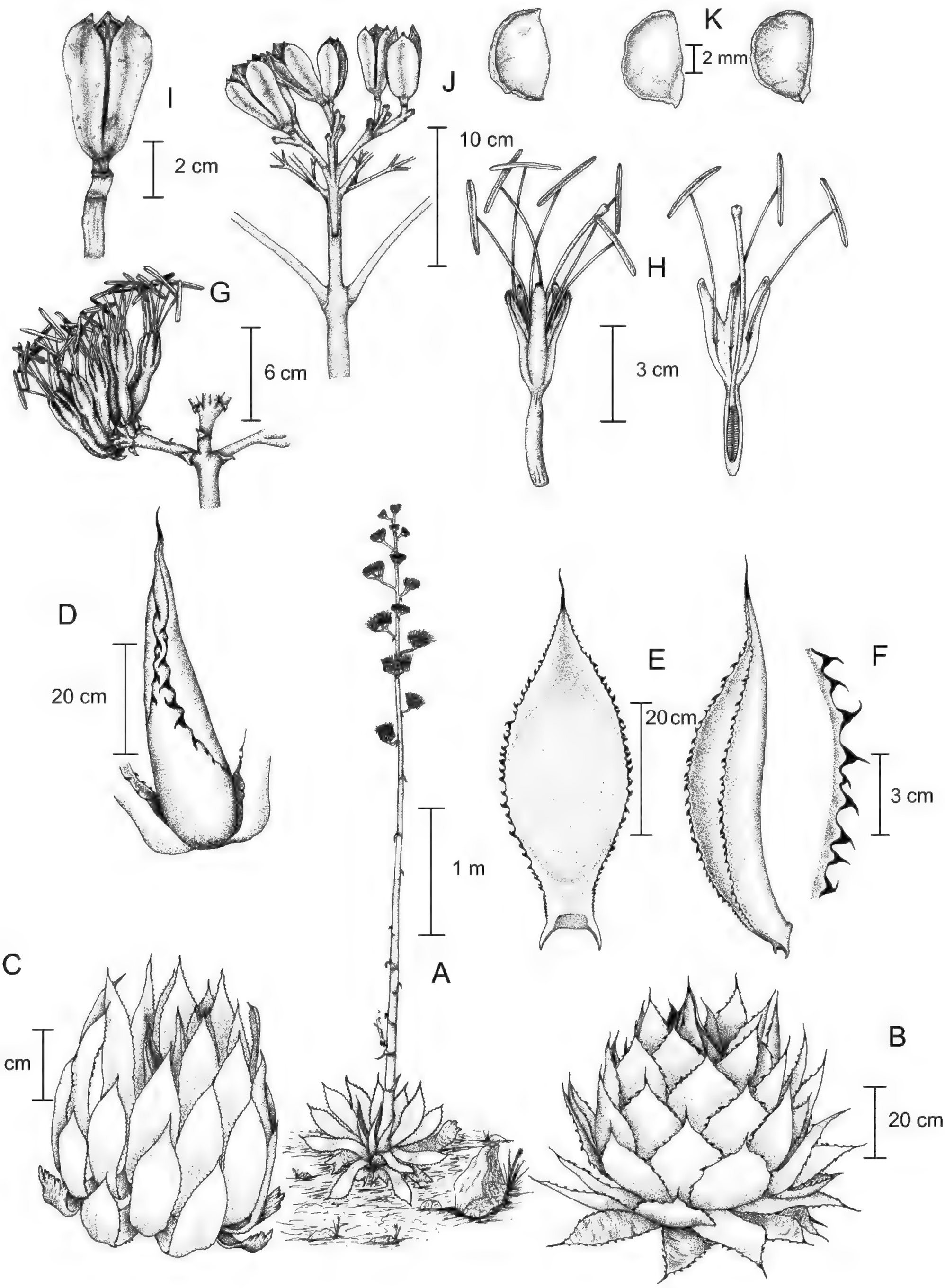

Figure 1. *Agave temacapulinensis* A. Vázquez & Cházaro. —A. Flowering plant (*Vázquez-García with Cházaro 9070* [IBUG]). —B, C. Rosettes (from Bajío de Temacapulín; photographs by Jesús Trujillo and Antonio Vázquez, respectively, 2011). —D. Central leaves. —E. Left, adaxial leaf surface; right, lateral view of leaf. —F. Blade margin (D–F from Sagrado Corazón de Jesús, Mexticacán; photographs by Antonio Vázquez, 2011). —G. Peduncle with flowers. —H. Left, lateral view of flower; right, longitudinal section (G and H from *Vázquez-García with Cházaro 9092* [IBUG]). —I. Mature capsule. —J. Peduncles with capsules. —K. Seeds, lateral view (I–K from *Vázquez-García with Cházaro 9098* [IBUG]).

Table 1. *Agave temacapulinensis* contrasted with related species of the Ditepalae group sensu Gentry. Data for *A. wocomahi* and *A. durangensis* from Gentry (1982).

Characters or environmental factors	*A. temacapulinensis*	*A. wocomahi*	*A. durangensis*
Habit	single to occasionally surculose	single	single to surculose
Rosette color	glaucous to light gray	dark green to glaucous green	glaucous gray
Leaf texture	smooth	smooth	rough
Margin shape	crenate	straight to undulate	crenate, mammillae
Teeth	8–10 mm, variously flexed, usually upward	10–20 mm, downflexed tips below mid-blade	10–20 mm, variously flexed
Spine	35–45 mm, flexuous, channeled above, long-decurrent, black to bluish gray	30–60 mm, stout, flattened or hollowed in a broad groove above, short or long-decurrent, black to bluish gray	40–60 mm, strong, broadly channeled above, pruinose gray over brown
Panicle	5.5–6(6.5) m	3–5 m	7–8 m
Lateral flowering branches	16 to 18	8 to 15	18 to 30
Capsules	40–51 × 14–18 mm	50–60 × 15 mm	45–60 × 16–18 mm
Seeds	5–6 × 3–4 mm	7 × 4.5–5 mm	4.5–6 × 3.5–4.5 mm
Elevation	1600–1700 m	1400–2500 m	1700–2600 m
Mean annual rainfall	553–700 mm	1076 mm	483.5 mm
Flowering peak	May–June	July–Sep.	July–Sep.
Habitat	calcareous substrate, *Juniperus* forest, thorn forest, and *Taxodium* gallery forest	calcareous substrate, pine-oak forest	volcanic (basaltic) substrate,* grassland, pine-oak forest, and occasionally tropical dry forest*

* Data from González and Galván (1992).

to these populations is the El Zapotillo dam project, which may flood nearly its entire habitat. *Agave temacapulinensis* is locally abundant, but is regionally rare. Thus, the new species is recommended for listing under the Mexican endangered species act (NOM-059-SEMARNAT, 2010) under the Special Protection category. A preliminary assessment of the conservation status of *A. temacapulinensis*, in accordance with the IUCN Red List Categories and Criteria (IUCN, 2001), suggests this species should be included in the category of Critically Endangered (CR), based on population reduction estimated to be greater than 80% projected for the near future (up to 10 years), based on direct observation. This conservation assessment is also based on a decline in area of occupancy, the extent of occurrence, and habitat quality, since the El Zapotillo dam project may flood almost its entire native habitat, as well as actual and potential levels of exploitation. The known extent of the occurrence of *A. temacapulinensis* is approximately 90 km^2 (between 102°42′–102°48′W and 21°09′–21°14′N), its area of occupancy is less than 10 km^2, the habitat is severely fragmented, and there are continuing declines in the observed number of mature individuals, their area of occupancy, and habitat quality.

Discussion. *Agave temacapulinensis* shares characters typical for the informal species group Ditepalae, sensu Gentry, which include the light glaucous rosettes, dimorphic tepals, and deep floral tube (Table 1). The new species is morphologically similar to *A. wocomahi*, in terms of the rosette size, solitary habit in most of the observed cases, smooth texture of leaves, and red-tipped, dimorphic tepals. *Agave temacapulinensis* differs from *A. wocomahi* in having the rosettes glaucous to light gray (vs. dark green to glaucous green), the leaf margins crenate (vs. straight to undulate), the leaf marginal teeth 8–10 mm (vs. 10–20 mm), the flowering stalks 5.5–6.5 m (vs. 3–5 m), the lateral branches more numerous, with 16 to 18 (vs. 8 to 15), the smaller seeds 5–6 × 3–4 mm (vs. 7 × 4.5–5 mm). *Agave temacapulinensis* has a flowering peak in late spring to early summer and grows in the ecotones between *Juniperus*, thorn, and *Taxodium* gallery forests, with a mean annual rainfall of 553–700 mm. This contrasts with *A. wocomahi*, which has a flowering peak in mid- to late summer and grows in pine-oak forest, with a mean annual rainfall of 1076 mm (Gentry, 1982; McVaugh, 1989). The new species is also morphologically similar to *A. durangensis* Gentry, in terms of overall size (80–115 cm tall) and color (glaucous to gray) of the rosettes, the red-tipped, dimorphic flowers, as well as the size

of the capsules (4–5.1 × 1.4–1.8 cm vs. 4.5–6 × 1.6–1.8 cm, respectively) and seeds (5–6 × 3–4 mm vs. 4.5–6.0 × 3.5–4.5 mm). However, the new species differs from the latter in having leaves with a smooth texture (vs. rough), marginal leaf teeth 8–10 mm (vs. 10–20 mm), as well as the flowering stalk 5–6.5 m (vs. 7–8 m), and lateral branches only 16 to 18 (vs. 18 to 30). *Agave temacapulinensis* has a flowering peak in late spring to early summer and grows at 1600–1700 m on calcareous substrate in the ecotones between *Juniperus*, thorn, and *Taxodium* gallery forest. This contrasts with *A. wocomahi*, which has a flowering peak in mid- to late summer and grows at 1700–2600 m, and occurs on volcanic basaltic substrate in open grassland, pine-oak, or tropical dry forest (Gentry, 1982; McVaugh, 1989).

Hernández-Vera et al. (2007) previously determined a specimen as belonging to the Ditepalae species group, sensu Gentry, from Lagos de Moreno, Jalisco, as *Agave wocomahi* (*Hernández-Vera et al. 39*; IBUG). However, that specimen has not been found at IBUG, and thus cannot be verified. Furthermore, additional material from the boundaries of Lagos de Moreno and Ojuelos, Jalisco, are identified as *A. asperrima* Jacobi by Vázquez-García et al. (2007), which is a common Chihuahuan Desert species, also abundantly found in the state of Aguascalientes (De La Cerda, 2004). Thus, it is not clear for now if *A. temacapulinensis* represents the first or the second record of group Ditepalae for Jalisco. Further fieldwork and fertile material are needed to clarify this matter.

Paratypes. MEXICO. **Jalisco:** Mpio. Cañadas de Obregón, camino de Palmarejo a Cofradía, 1690 m, 5 May 2010 (fl.), *Vázquez-García with Cházaro 9070* (IBUG, MEXU); Mpio. Cañadas de Obregón, Barranca del Río Verde, entre Temacapulín y Palmarejo, 12 June 2010 (fr.), *Cházaro with López-V. 9817* (IBUG, IEB, XAL) [distributed as *Agave americana* var. *expansa* (Jacobi) Gentry]; Mpio. Cañadas de Obregón, camino El Zapotillo al Río Verde, 24 Apr. 2011 (st.), *Vázquez-García with Cházaro 9093* (IBUG); Mpio. Cañadas de Obregón, Bajío de Temacapulín, camino hacia Palmarejo, 1670 m, 24 Apr. 2011 (fr.), *Vázquez-García with Cházaro 9098* (IBUG); Mpio. Jalostotitlán, 30 Apr. 2011 (sterile, cult.), *Vázquez-García with Cházaro 9099* (IBUG); Mpio. Mexticacán, márgenes del Río Acasico, 24 Apr. 2011 (sterile), *Vázquez-García with Cházaro 9094* (IBUG).

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On the Type of *Pseudosporochnus* (Fossil Cladoxylopsida)

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ABSTRACT. *Pseudosporochnus* Potonié & Bernard (1904; fossil Cladoxylopsida) has been viewed as one of the iconic vascular plants in the Middle Devonian, but the type of the generic name remains problematic. Although *P. verticillatus* (Krejčí) Obrhel has been previously regarded as the type of the generic name, its so-called basionym *Chondrites verticillatus* Krejčí was not validly published and thereby has no nomenclatural status. Thus, the specific epithet *verticillatus* has no priority over *krejcii*, which Potonié and Bernard first used (1904) for the species of *Pseudosporochnus*, and the combination *P. verticillatus* was not validly published. The name *P. verticillatus* that Obrhel intended to combine in 1961 is rather a new species name and should be cited as *P. verticillatus* Krejčí ex Obrhel. However, *P. verticillatus*, when published (Obrhel, 1961), was an illegitimate superfluous name for *P. krejcii* (Stur) Potonié & Bernard. Both names attach to a lectotype designated by Obrhel (i.e., D-364, National Museum at Prague) and were originally used under the name *Sporochnus krejcii* Stur. *Pseudosporochnus krejcii* (Stur) Potonié & Bernard should be the type of *Pseudosporochnus* Potonié & Bernard.

Key words: Cladoxylopsida, Middle Devonian, *Pseudosporochnus*.

Pseudosporochnus Potonié & Bernard, as an extinct vascular plant, has received extensive attention and been reported from the Middle Devonian of Scotland, the Czech Republic, Belgium, Germany, Estonia, Romania, Kazakhstan, South China, Norway, and the United States (Potonié & Bernard, 1904; Arber, 1921; Hirmer, 1927; Lang, 1927; Høeg, 1931, 1942; Kräusel & Weyland, 1933; Leclercq, 1940, 1970; Obrhel, 1959, 1960, 1961; Leclercq & Banks, 1962; Răleanu & Semaka, 1966; Stockmans, 1968; Jurina, 1969; Schweitzer & Cai, 1987; Kalamees, 1988; Stein & Hueber, 1989; Berry & Fairon-Demaret, 1997, 2002; Schweitzer, 1999; Berry, 2008; Xue & Hao, 2008). *Pseudosporochnus* is characterized by its digitate branching pattern, terminal sporangia, and dissected xylem strands. The fossil taxon was assigned to its own family (Pseudosporochnaceae), order (Pseudosporochnales), and in turn to the Cladoxylopsida (Pichi-Sermolli, 1958, 1959; Leclercq & Banks, 1962; Berry & Stein, 2000; Taylor et al., 2009; Xue et al., 2010), which was the first plant group to attain an arborescent habit, forming one of the earliest known forests on the Earth (Dilcher et al., 2004; Meyer-Berthaud & Decombeix, 2007, 2009; Stein et al., 2007; Meyer-Berthaud et al., 2010). Phylogenetically, *Pseudosporochnus* is of significance in that it has been considered one of the stem groups or candidate ancestors of the ferns and/or sphenopsids (Stein et al., 1984; Kenrick & Crane, 1997; Wang & Guo, 2009). To date, eight species names have been used in *Pseudosporochnus* (Potonié & Bernard, 1904; Obrhel, 1959, 1960, 1961; Leclercq & Banks, 1962; Leclercq, 1970; Mustafa, 1978; Schweitzer & Cai, 1987; Kalamees, 1988; Stein & Hueber, 1989). However, the nomenclature of some of the species names and in particular the generitype of *Pseudosporochnus* remains problematic. In this paper, we intend to clarify the type of *Pseudosporochnus*.

Krejčí (1882) briefly described three kinds of fossil fucoids, which he described as *Haliserites zonarioides* Krejčí, *H. spinosus* Krejčí, and *Chordrites verticillatus* Krejčí, from the Middle Devonian of Bohemia, Czech Republic. Neither the cited specimens nor the illustrations were presented by Krejčí. It can be inferred that Krejčí utilized Sternberg's (1833) system of classification on fossil fucoids, as he mentioned two of his generic names, i.e., *Zonarites* Sternberg and *Haliserites* Sternberg. Meanwhile, the spelling as *Chordrites* was thought to be a typographical error or a lapsus calami (i.e., a slip of the pen) for the fossil fucoid generic name *Chondrites* Sternberg, 1833 (Stur, 1882; Potonié & Bernard, 1904; Obrhel, 1961), because there is no other internal evidence that

Krejčí intended to propose a new generic name. Krejčí (1882: 69) explicitly stated that *H. zonarioides*, *H. spinosus*, and *C. verticillatus* were "vorläufig" or "vorläufiger Name," or provisional names.

As for *Chordrites verticillatus*, Krejčí's (1882: 69) original description in Old German is presented here: "Sehr zahlreich sind einzelne fein verzweigte strauchartige Formen, die in wirbelförmige, wie es scheint fructificirende Ästchen auslaufen. Sie wird vorläufig als Chordrites verticillatus Kr. Fixirt," which was translated into English (by Christian Pott, 2012, pers. comm.): "Individual, delicately branched, shrub-like forms are very common, which branch out into curly, apparently fructifying twigs. This is provisionally named as *Chordrites verticillatus* Kr." According to the *International Code of Botanical Nomenclature* (ICBN, Vienna Code, Art. 34.1b, Ex. 5, McNeill et al., 2006), *Chondrites verticillatus* Krejčí is a provisional name and was not validly published.

Soon after publication of *Chondrites verticillatus* Krejčí, Stur (1882: 343) cited it under a new name *Sporochnus krejčíi* Stur, which was used and illustrated for similar fossil algae from Srbsko, Bohemia. Stur's (1882: 342) original description is presented here "*Sporochnus krejčíi* Stur Taf. II Fronde compressa, ramis decompositis virgata, comosa; receptaculis clavatocylindraceis, in pedicellum ipsis multo longio-rem attenuata," but he did not designate a type specimen. Here, the specific epithet "*krejčíi*" should be standardized as "*krejcii*" by Article 60C.2 of the ICBN (McNeill et al., 2006).

Based on some of the original specimens of *Sporochnus krejcii* Stur and *Hostinella hostinensis* Barrande as identified by Stur (1882), Potonié and Bernard (1904: 10, 34, fig. 70) discovered evidence of tracheids, such that they reclassified these specimens as a new genus and species in Psilotaceae (?), i.e., *Pseudosporochnus krejcii* (Stur) Potonié & Bernard. Potonié and Bernard (1904: 25) provided an elaborated description for *P. krejcii*, but they did not designate a type specimen. According to the ICBN (Art. 42.1, McNeill et al., 2006), *Pseudosporochnus* Potonié & Bernard and *P. krejcii* were validly published, simultaneously established by provision of a single description, i.e., descriptio generico-specifica.

Obrhel (1959) subsequently argued that the specific epithet *verticillatus* had priority over *krejcii*. Consequently, Obrhel (1959: 386; 1960: 102) combined the names of the Bohemian fossils, synonymizing *Pseudosporochnus krejcii* under *P. verticillatus* (Krejčí) Obrhel, and accepted the latter name as the type of *Pseudosporochnus*. In both instances, however, Obrhel failed to designate a type specimen, so *P. verticillatus* was not validly published (Art. 37.1, ICBN, McNeill et al., 2006). Obrhel (1961: 12) continued to use the combination *P. verticillatus* and did later designate a lectotype for *P. verticillatus* (i.e., D-364, National Museum at Prague). This specimen had been originally identified under the name *Sporochnus krejcii* Stur (Stur, 1882: 342, pl. 2, fig. 1). Since then, Obrhel's proposal to treat *P. verticillatus* (Krejčí) Obrhel as the type of *Pseudosporochnus* has been adopted by subsequent palaeobotanists (Leclercq & Banks, 1962; Leclercq, 1970; Kalamees, 1988; Berry & Fairon-Demaret, 1997, 2002; Schweitzer, 1999).

In our opinion, the so-called basionym *Chondrites verticillatus* Krejčí was not validly published and had by no means nomenclatural status (ICBN, Arts. 12.1, 34.1b, McNeill et al., 2006), thus Obrhel's argument was untenable. Consequently, the combination *P. verticillatus* (Krejčí) used by Obrhel in 1959 was not validly published (ICBN, Art. 33.4, McNeill et al., 2006), and the name *P. verticillatus* that Obrhel intended to combine in 1961 was actually a new species name and should be cited as *P. verticillatus* Krejčí ex Obrhel.

According to the ICBN (Arts. 11.4, 11.5, and 52.1, McNeill et al., 2006), *Pseudosporochnus verticillatus* Krejčí ex Obrhel, when published, was an illegitimate and superfluous name for *P. krejcii* (Stur) Potonié & Bernard; both of these names attach to the lectotype originally applied to the name *Sporochnus krejcii* Stur. Hence, we conclude that the earlier and valid name *P. krejcii* (Stur) Potonié & Bernard (1904) should be the type of *Pseudosporochnus* Potonié & Bernard, whose publication would be more precisely dated as "Jan-Mar 1904" in *Taxonomic Literature*, 2nd edition (Stafleu & Cowan, 1983: 362).

Pseudosporochnus Potonié & Bernard, Fl. Dévon., 25. 1904 [fossil Cladoxylopsida]. TYPE: *Pseudosporochnus krejcii* (Stur) Potonié & Bernard [≡ *Sporochnus krejcii* Stur]. *Sporochnus krejcii* Stur, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl. 84: 342. 1882.

Pseudosporochnus krejcii (Stur) Potonié & Bernard, Fl. Dévon., 25. 1904. *Pseudosporochnus verticillatus* Krejčí ex Obrhel, Sborník Ústřed. Ústavu Geol., Paleontol. 26: 12. 1961, nom. illeg. superfl. TYPE: Bohemia [Czech Republic]. Beroun Town, Srbsko, Late Middle Devonian (Givetian), Srbsko Formation, D-364 (lectotype, designated by Obrhel [1961: 12], National Museum of Prague).

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Polystichum yaanense (Dryopteridaceae), a Remarkable New Species from Sichuan, China

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Abstract. A new fern species, *Polystichum yaanense* Liang Zhang & Li Bing Zhang (Dryopteridaceae), is described from Bifengxia, or the Bluish Green Peak Canyon, in Ya'an Prefecture in Sichuan Province, China. The new species is morphologically unique in having yellowish green leaves, a thin but firm leaf texture, veins visible on the adaxial leaf surface, and narrowly ovate to lanceolate rachis scales. Ecologically, the new taxon grows in acidic soils, in contrast to other species in section *Haplopolystichum* Tagawa. *Polystichum yaanense* is considered to be Critically Endangered (CR), based on IUCN Red List criteria. Ten other species of *Polystichum* Roth occur in the type locality within the same canyon; all 11 species are distinguished from one another by a dichotomous key based on morphology.

Key words: China, IUCN Red List, *Polystichum*, Sichuan.

In December 2008, Hai He, a pteridologist based at the CTC Herbarium, affiliated with Chongqing Normal University, noticed images of fern species on the Internet posted by the first author (L.Z.). The images of a noteworthy species of *Polystichum* Roth (Dryopteridaceae) caught Hai He's attention and were later forwarded to the second author (L.-B.Z.), who immediately realized that it was an undescribed species. Subsequent fieldwork was conducted on 15 March 2009, and the new species is described here.

The type locality is in Bifengxia, or the Bluish Green Peak Canyon, which is located in the Ya'an Prefecture directly north of Ya'an City in Sichuan Province. The locale is a scenic area known for its well-protected vegetation and for the Giant Panda Reserve. The canyon itself is about 13 km long and is composed of two segments that form a V shape. Streams and waterfalls run perennially in the canyon. The second author (L.-B.Z.) has also identified two more localities of the new species that were collected by Wen-Pei Fang in 1930 in neighboring Hongya County, to the east in Sichuan, but no further information was available to describe the habitat.

Polystichum yaanense Liang Zhang & Li Bing Zhang, sp. nov. TYPE: China. Sichuan: Ya'an Prefecture, Yucheng Distr., Bifengxia Town, Bifeng Village, Bifengxia, 30°4′17.51″N, 102°59′48.74″E, 950 m, 15 Mar. 2009, sandstone substrate, in acidic soil, *L.-B. Zhang, Y. Wang & L. Zhang 4745* (holotype, CDBI; isotypes, CDBI, MO, SAUF). Figures 1, 2.

Species insignis lamina foliari luteolo-viridi textura tenui sed dura, venis adaxialiter visibilibus atque squamis rhachidis anguste ovatis usque lanceolatis, a speciebus sectionis *Haplopolystichi* Tagawa nobis notis bene distincta.

Plants perennial, caespitose, evergreen, 8–15(–30) cm tall; rhizome short, 0.5–1 cm, ascending; scales ovate to lanceolate, chartaceous, light brown, 0.4–3.6 mm; roots dark brown when dry, to 10 cm, ca. 0.6 mm diam., sparsely to densely covered with scales. Leaves 5 to 11 per rhizome; petiole 1.5–3(–7) cm, 0.5–1.2 mm diam. at mid-portion, adaxially canalic-

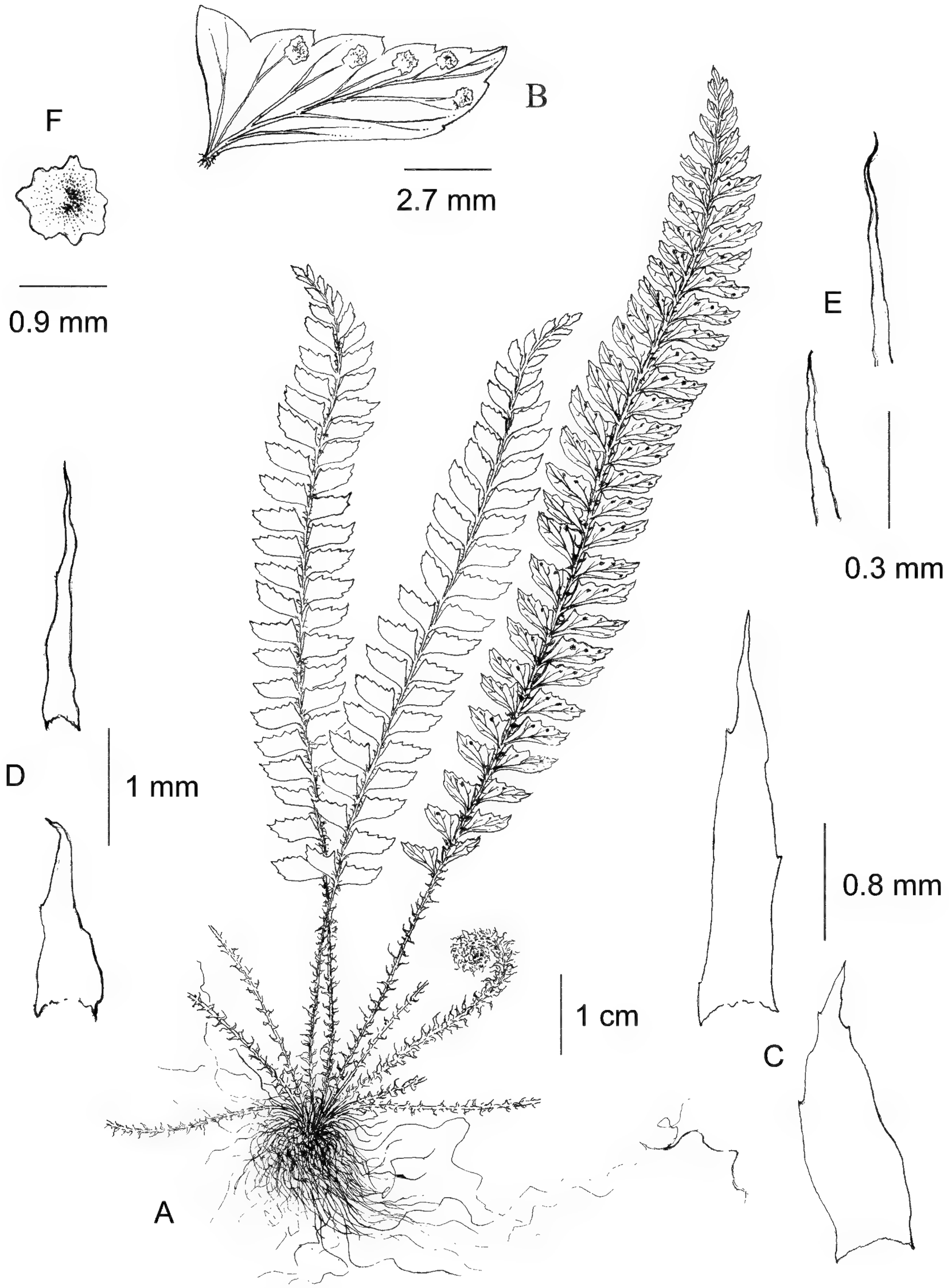

Figure 1. *Polystichum yaanense* Liang Zhang & Li Bing Zhang. —A. Plant habit. —B. Pinna. —C. Scales from base of petiole. —D. Rachis scales. —E. Narrow-type microscales. —F. Indusium. A–F taken from the holotype *L.-B. Zhang, Y. Wang & L. Zhang 4745* (CDBI).

ulate, green; basal petiole scales narrowly ovate to lanceolate (Fig. 1C), 2.7–3.4 × 0.8–1.1 mm, variable in size, thinly chartaceous and brown at mid-portion, membranous and light brown on margin, composed of multiple cell layers, margin subentire, apex acuminate or caudate, matte; distal petiole scales similar but narrower and shorter toward rachis apex, lanceolate or narrowly ovate, membranous, brown,

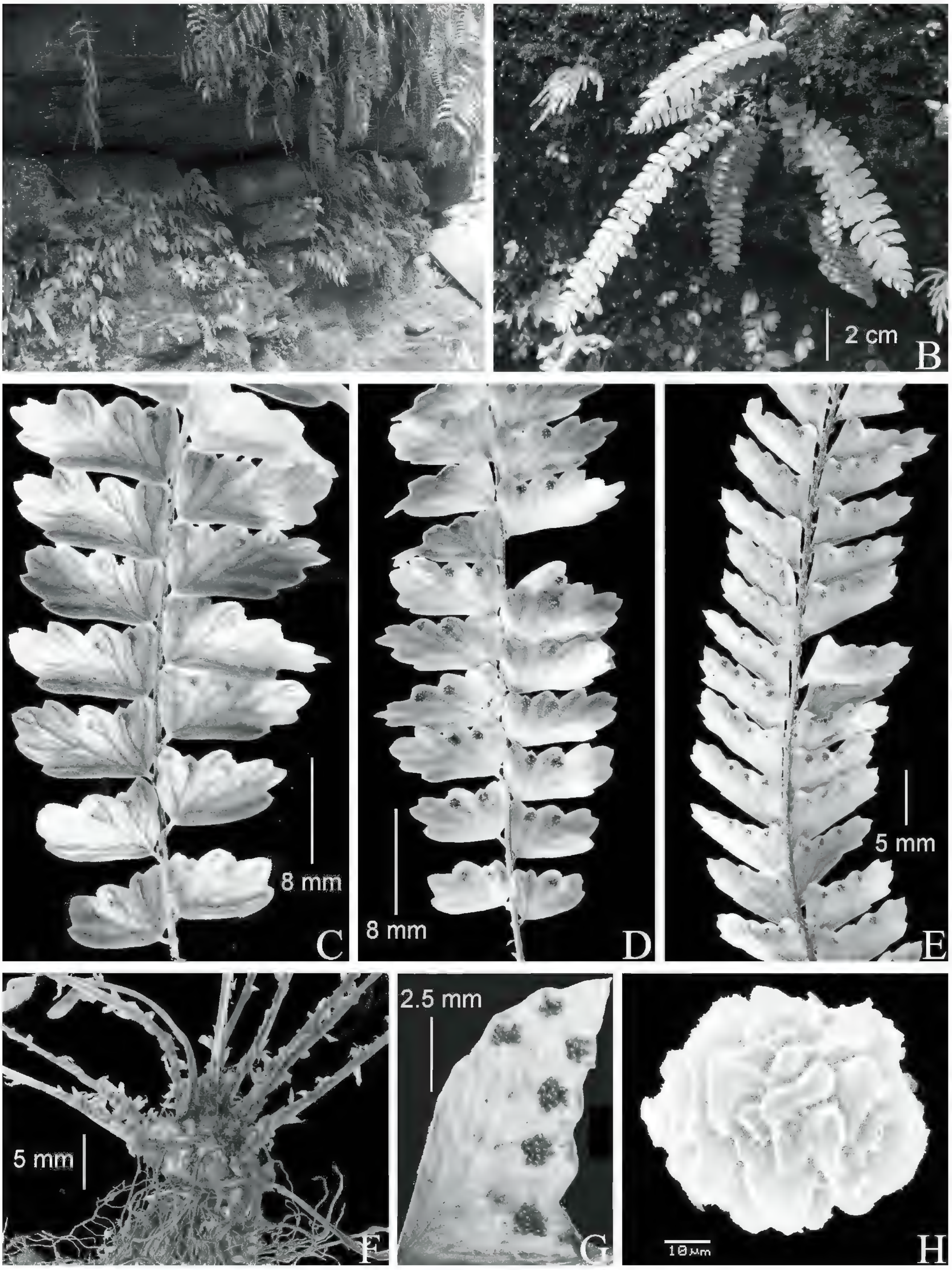

Figure 2. *Polystichum yaanense* Liang Zhang & Li Bing Zhang. —A. Habitat at the type locality in Bifengxia. —B. Plant habit. —C. Lower portion of adaxial lamina. —D. Lower portion of abaxial lamina. —E. Portion of abaxial lamina of a different plant. —F. Lower portion of plant showing petiole scales. —G. Abaxial view of pinna showing the marginal sori. —H. SEM equatorial view of spore. H taken from the holotype *L.-B. Zhang, Y. Wang & L. Zhang 4745* (CDBI).

margin subentire or slightly serrate, apex caudate, matte. Leaf lamina lanceolate, slightly contracted from the basal 4 pairs toward base, 1-pinnate, 6–12(–23) cm, 1.4–2 cm wide, apex acute and apical 4 or 5 pinna pairs contracted toward apex; rachis 0.7–1.2 mm diam. at mid-portion, without proliferous buds, adaxially sulcate; rachis scales 1.5–3.2 mm, base 0.3–1 mm wide, narrowly ovate to lanceolate, differing in size, chartaceous, light brown, margin occasionally ciliate (cilia not evident, Fig. 1D), apex caudate, matte; pinnae usually in 10 to 26 pairs, not overlapping, pointing upward, the basal 2 pairs 0.5–1.3 cm apart, ± alternate, yellowish green, oblong, the largest pinnae 8.2–10.1(–17) × 4.5–5.1(–7) mm, located at mid-lamina, shortly petiolulate; petiolules ca. 1.5 mm, coriaceous, the acroscopic base auriculate, the basiscopic base truncate, often at 90°–120° angles to rachis, pinna apex obtuse, acroscopic margin repand, serrate and without aristate spinules, abaxially scaly, adaxially lustrous and glabrous; microscales on abaxial pinna surface subulate, without dilated base (narrow-type microscales), 0.3–0.9 mm, base 0.12–0.24 mm wide, ciliate on margins (cilia not evident, Fig. 1E); venation pinnate; midrib abaxially slightly raised, adaxially flat but clearly visible; lateral veins free, usually in 3 or 4 pairs from midrib per pinna, nearly opposite, each lateral vein further dichotomous, distinct on both surfaces; sori terminal on veins of pinnae, (1)2 to 5(6) per fertile pinna (Fig. 1B), adjacent, ca. 0.9 mm from pinna margin; all pinnae on fertile lamina fertile; indusia peltate (Fig. 1F), 0.7–1.1 mm diam., membranous, brown, margin erose.

Spore morphology. The spores of *Polystichum yaanense* are round in polar view and elliptic in equatorial view. The spore size is ca. 54.2 × 62.2 μm (polar axis × equatorial axis). The ratio of the length of the polar axis to that of the equatorial axis is ca. 1.15:1. The perispore sculpture is verrucate, and the verrucae are normally more than 5 μm wide (Fig. 2H).

Distribution and ecology. *Polystichum yaanense* is described from the Ya'an Prefecture in Sichuan Province on the basis of four collections from the type locality in Bifengxia, Yucheng District. An additional two collections were discovered by the second author (L.-B.Z.) at Kew that date to 1930 from adjacent Hongya County in Sichuan, directly to the east of Ya'an City, but further details for this locale are not available. In the canyon at Bifengxia, *P. yaanense* grows in shallow acidic soils on moist and shady sandstone cliff faces at an elevation of ca. 950 m. The plants were observed 0.5–1.5 m above the ground, about 10 m away from a perennial stream. Sandstone substrate and similar habitat are not rare in western and central Sichuan, and it is thus possible that this species may occur in neighboring areas. Plants immediately associated with *P. yaanense* on these sandstone cliffs include the moss *Sphagnum* L. (Sphagnaceae); the ferns *Hicriopteris glauca* (Thunb. ex Houtt.) Ching (Gleicheniaceae), *P. acutidens* Christ (Dryopteridaceae), and *Stegnogramma cyrtomioides* (C. Chr.) Ching (Thelypteridaceae); and the lycophyte *Selaginella delicatula* (Desv. ex Poir.) Alston (Selaginellaceae).

Other plants found within 10 m of *Polystichum yaanense* include the ferns *Asplenium tripteropus* Nakai, *A. cataractarum* Blume (Aspleniaceae), *Diplazium subsinuatum* (Wall. ex Hook. & Grev.) Tagawa (Athyriaceae), *Lindsaea cultrata* (Willd.) Sw. (Lindsaeaceae), *Parathelypteris glanduligera* (Kunze) Ching (Thelypteridaceae), *Polystichum deltodon* (Baker) Diels, and *P. xiphophyllum* (Baker) Diels. Seed plant associates were *Asarum caudigerum* Hance (Aristolochiaceae), *Asystasiella neesiana* (Wall.) Lindau (Acanthaceae), *Begonia limprichtii* Irmsch. (Begoniaceae), *Dichocarpum auriculatum* (Franch.) W. T. Wang & P. G. Xiao (Ranunculaceae), *Elatostema cuspidatum* Wight (Urticaceae), *Fordiophyton faberi* Stapf (Melastomataceae), *Impatiens oxyanthera* Hook. f. (Balsaminaceae), *Loxostigma griffithii* (Wight) C. B. Clarke (Gesneriaceae), *Lysimachia paridiformis* Franch. var. *stenophylla* Franch. (Primulaceae), *Millettia dielsiana* Harms (Fabaceae), *Ophiorrhiza* L. (Rubiaceae), *Pellionia radicans* (Siebold & Zucc.) Wedd. (Urticaceae), *Rubus corchorifolius* L. f. (Rosaceae), *Saxifraga stolonifera* Curtis (Saxifragaceae), *Sinosenecio oldhamianus* (Maxim.) B. Nord. (Asteraceae), *Stachyurus chinensis* Franch. (Stachyuraceae), and *Whytockia tsiangiana* (Hand.-Mazz.) A. Weber var. *wilsonii* A. Weber (Gesneriaceae).

IUCN Red List category. Only three populations with a total of ca. 45 individuals of *Polystichum yaanense* have been found so far in Ya'an Prefecture, at the type locality in Bifengxia canyon. These populations consisted of 25, 15, and five plants, respectively, and were about 20 m, 600 m, and 600 m apart from one another. No information is available for populations in Hongya County, and the modern presence of *P. yaanense* was not confirmed at this second locality. The status of the new species is classified as Critically Endangered (CR), according to IUCN guidelines (IUCN, 2008). Although the type locality is in a protected nature reserve, hiking trails currently pass near the populations of *P. yaanense*, and the trails are heavily used in summer, which

raises significant conservation concern. This has been brought to the attention of the agency responsible for the management of Bifengxia, stressing the need to ensure the proper conservation of this habitat.

Etymology. The epithet of the new species is taken from the Chinese pinyin "yaan," for the name of the type locality in the Ya'an Prefecture in Sichuan, China, and from the Latin suffix "-ense," meaning "of origin or place."

Discussion. Morphologically, we expected *Polystichum yaanense* to share a close relationship with species in *Polystichum* sect. *Haplopolystichum* Tagawa. The new species has no bulbils on its rachis and has only free venation on the pinnae, which better corresponds to the core species group of *Polystichum* sect. *Haplopolystichum*. However, *P. yaanense* is unique within the entire *Polystichum* sect. *Haplopolystichum* s.l. (Zhang & He, 2009) in having yellowish green leaves with a thin but firm chartaceous texture, the adaxially visible veins on the pinnae, and the rachis scales that are variably narrowly ovate to lanceolate. *Polystichum* sect. *Haplopolystichum* is typically characterized by green leaves with soft chartaceous or firm coriaceous (but not firm chartaceous) texture, the adaxially indistinct venation on the pinnae, and rachis scales that are linear or lanceolate.

The verrucate perispore sculpture of *Polystichum yaanense* (Fig. 2H) is more or less similar to that of *P. excelsius* Ching & Z. Y. Liu in *Polystichum* sect. *Sphaenopolystichum* Ching ex W. M. Chu & Z. R. He (as "17, *P. xichouense*," nom. nud., Xiang, 1992: 94) and that of *P. oligocarpum* Ching ex H. S. Kung & Li Bing Zhang in *Polystichum* sect. *Metapolystichum* Tagawa (Zhang & Kung, 1994). However, the perispore sculpture of the majority of the 89 Chinese species currently known for *Polystichum* sect. *Haplopolystichum* s.l. is unknown.

The ecological preference of *Polystichum yaanense* for acidic soils distinguishes the new taxon within *Polystichum* sect. *Haplopolystichum* s.l. Other species in this section that are also documented from acidic soils include *P. balansae* Christ, *P. falcatilobum* Ching ex W. M. Chu & Z. R. He, *P. formosanum* Rosenst., *P. hancockii* (Hance) Diels, *P. hookerianum* (C. Presl) C. Chr., and *P. tripteron* (Kunze) C. Presl.

Including the new species *Polystichum yaanense*, 11 species of *Polystichum* representing five sections have now been found in the area of Bifengxia. The other 10 are *P. acutidens* Christ, *P. deltodon* (Baker) Diels, *P. falcatilobum*, *P. hecatopterum* Diels (these four in *Polystichum* sect. *Haplopolystichum*), *P. erosum* Ching & K. H. Shing (*Polystichum* sect. *Mastigopteris* Tagawa), *P. longipaleatum* Christ, *P. makinoi* (Tagawa) Tagawa (these two in *Polystichum* sect. *Metapolystichum* Tagawa), *P. altum* Ching ex Li Bing Zhang & H. S. Kung, *P. longispinosum* Ching ex Li Bing Zhang & H. S. Kung (these two in *Polystichum* sect. *Neopolystichum* Ching ex Li Bing Zhang & H. S. Kung), and *P. xiphophyllum* (Baker) Diels (*Polystichum* sect. *Xiphopolystichum* Daigobo). These species are distinguished in the following taxonomic key.

KEY TO SPECIES OF *POLYSTICHUM* FROM BIFENGXIA, YA'AN PREFECTURE, IN SICHUAN, CHINA

1a. Lamina pinnate 2
2a. Rachis without bulbils 3
3a. Pinnae without long spinules on margin 4
4a. Pinnae without visible veins on adaxial lamina surface; leaf lamina chartaceous, uniformly green; rachis scales lanceolate 5
5a. Pinnae falcate-lanceolate 6
6a. Pinnae chartaceous; sori located between midrib and pinna margin ..... *P. acutidens*
6b. Pinnae coriaceous; sori located adjacent to pinna margin ..... *P. falcatilobum*
5b. Pinnae oblong ..... *P. deltodon*
4b. Pinnae with visible veins on adaxial surface; leaf lamina thin but firmly chartaceous, yellowish green; rachis scales ovate-lanceolate .... *P. yaanense*
3b. Pinnae with long spinules on margin ..... *P. hecatopterum*
2b. Rachis with a bulbil at apex ..... *P. erosum*
1b. Lamina bipinnate 7
7a. Leaf lamina chartaceous; rachis scales brown and lanceolate 8
8a. Microscales lanceolate (broad-type) 9
9a. Pinnules with long spinules on margin ..... *P. longispinosum*
9b. Pinnules without long spinules on margin ... *P. altum*
8b. Microscales linear (narrow-type) 10
10a. Petiole scales concolorous; pinnules exauriculate; microscales fibrillose ..... *P. longipaleatum*
10b. Petiole scales bicolorous; pinnules auriculate; microscales linear but not fibrillose ..... *P. makinoi*
7b. Leaf lamina coriaceous; rachis scales dark brown and linear ..... *P. xiphophyllum*

Paratypes. CHINA. **Sichuan:** Hongya Co., 21 Aug. 1930, *W.-P. Fang 8480* (K, SZ); 22 Aug. 1930, *W.-P. Fang 8606* (K, SZ); Ya'an Prefecture, Yucheng Distr., Bifengxia Town, Bifeng Village, Bifengxia, 30°4′17.51″N, 102°59′48.74″E, sandstone cliffs, 0.5–1.5 m above ground, 950 m, 4 Aug. 2009, *L. Zhang 701* (CDBI, MO, SAUF), *705*, *716* (SAUF).

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spores, and to Fa-Qiang Lü for the line art. Special thanks go to Ning Wu and Xinfen Gao for their collegial support and George Yatskievych, Christopher Fraser-Jenkins, and Victoria Hollowell for their helpful comments. The curators of the herbaria CDBI, MO, SAUF, and SZ kindly provided access to the material in their care.

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Polystichum normale (Dryopteridaceae), a New Species in Section *Crucifilix* from Guizhou, China

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ABSTRACT. A new fern species, *Polystichum normale* Ching ex P. S. Wang & Li Bing Zhang (Dryopteridaceae), is described from Guizhou and illustrated for section *Crucifilix* Tagawa. Distributed in southern Chongqing, northeastern and southeastern Guizhou, and northwestern Hunan, China, the new species is morphologically similar to *P. tripteron* (Kunze) C. Presl and *P. hancockii* (Hance) Diels. *Polystichum normale* has toothed and oblong or almost rectangular pinnae with an acute apex. In contrast, *P. tripteron* has coarsely serrate and falcate-lanceolate pinnae with an acuminate apex. While *P. normale* has sori close to the pinna margins, indusia 0.6–0.8 mm in diameter, and a perispore with an irregularly perforate sculpture, *P. hancockii* has sori closer to the costa, indusia 0.3–0.4 mm in diameter, and a perispore with reticulate sculpture. It is considered Vulnerable (VU), based on IUCN Red List criteria.

Key words: China, Dryopteridaceae, Guizhou, IUCN Red List, *Polystichum*.

While in San Francisco in April 2009, the first author (L.-B.Z.) examined the collections of *Polystichum* Roth (Dryopteridaceae) and allies at the CAS herbarium. A specimen from the collection *Sino-Amer. Exp. 388* of *Polystichum*, collected on 27 August 1986 from northeastern Guizhou, China, had reflexed pinnae and almost upright, obtuse teeth on pinna margins. Its reflexed pinnae resemble those of *P. deflexum* Ching & W. M. Chu, but the tooth shape of the pinnae was very different. The reflexed pinnae and teeth, as well as the sori spread across the entire pinnae, distinguished the specimen from *P. submarginale* (Baker) Ching ex P. S. Wang. After returning to St. Louis, L.-B.Z. sent images of this specimen to the second author (P.-S.W.), who in fact had collected many specimens of this undescribed taxon since October 1985, initially from Mt. Leigong in Guizhou, and had long recognized this as a distinct species. Subsequent herbarium examinations in CDBI, HGAS, KUN, PE, PYU, and Herbarium Pei-Shan Wang, as well as molecular (Zhang, unpublished) and palynological work, confirm that this species is new to science. We now validly publish the previously ined. name *P. normale* used by Ching based on material collected by P.-S.W.

Polystichum normale Ching ex P. S. Wang & Li Bing Zhang, sp. nov. TYPE: China. Guizhou: Jiangkou Co., Fanjing Shan, Zhuantang, Huangba Cun, 27°46′19.96″N, 108°44′0.18″E, 600 m, sandstone substrate, acidic soil, 20 Sep. 2007, *L.-B. Zhang, H. He, B. Xu & Y. Wang 635* (holotype, CDBI; isotypes, CTC, MO). Figures 1, 2.

Species (sectionis *Crucifilicis* Tagawa) *Polysticho tripteronti* (Kunze) C. Presl et *P. hancockii* (Hance) Diels affinis, sed a *P. tripteronte* pinnis dentatis oblongis vel fere rectangularibus apice acutis, a *P. hancockii* soris prope margines pinnarum dispositis, indusiis 0.6–0.8 mm diam. atque perisporarum sculptura irreulariter perforata differt.

Plants perennial, evergreen, (11–)16–33 cm tall; rhizome short, 0.5–2 cm, ascending or erect; scales narrowly ovate, chartaceous, light brown to brown, 3–4 mm; roots dark brown to brown when dry, to 7 cm, 0.2–0.3 mm diam., sparsely covered with hairlike scales. Leaves caespitose; 4 to 7 per rhizome; petiole (4–)6–17 cm, (0.4–)0.7–2.6 mm, median diam., adaxially canaliculate, green, stramineous when dry; basal petiole scales (Fig. 1C) narrowly ovate to lanceolate, 5–7 × 1.2–1.5 mm, thinly chartaceous and brown at mid-portion, membranous and light brown marginally, the margin almost entire, apex acuminate or caudate, matte; distal petiole scales similar but narrower and shorter toward rachis apex, lanceolate or less often narrowly ovate, membranous, light brown, margin ciliate, apex caudate, matte; leaf

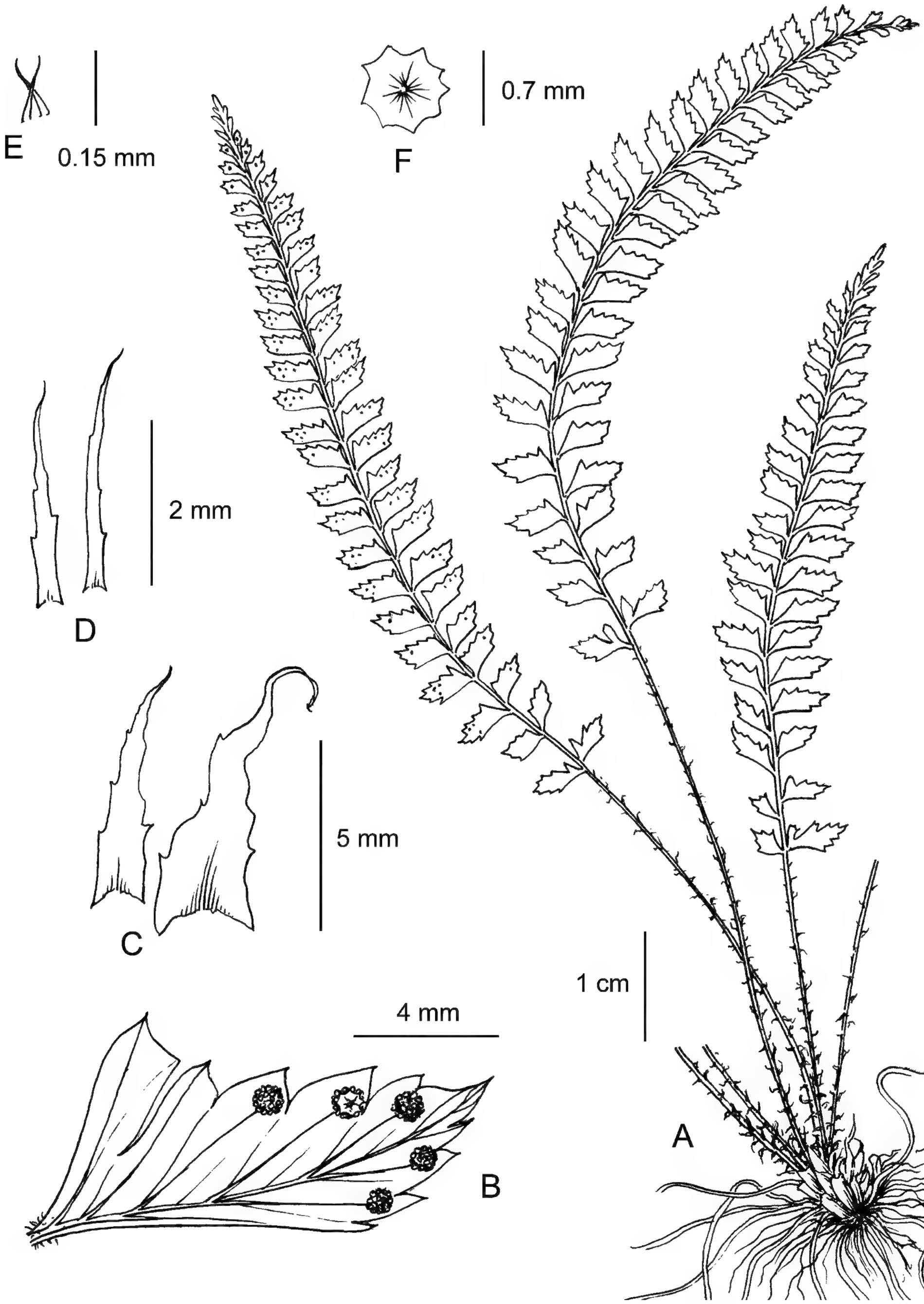


Figure 1. *Polystichum normale* Ching ex P. S. Wang & Li Bing Zhang. —A. Habit. —B. Pinna with sori. —C. Scales from base of petiole. —D. Rachis scales. —E. Narrow-type microscales from abaxial surface of pinna. —F. Indusium. Drawings taken from the paratype *P.-S. Wang F0606* (CDBI).

lamina lanceolate, slightly contracted toward base, 1-pinnate, (6–)9–27 × 1.9–3.3 cm wide at mid-portion, apex acuminate; rachis 0.7–1.3 mm in median diam., without proliferous buds, adaxially sulcate; rachis scales 1.5–3 × 0.3–0.7 mm, variable in size, membranous, light brown, margin ciliate, apex caudate, matte (Fig. 1D); pinnae in 14 to 28 pairs, not overlapping, pointing upward, basalmost pairs

simple, pinnatifid or 1-pinnate, 8–35 × 3.5–12 mm, the basal 2 pairs 0.7–1.4 cm apart, alternate, green, oblong to nearly rectangular, middle pinnae 9–17 × 3.5–7.2 mm, shortly petiolulate, with petiolules ca. 1.2 mm, chartaceous, acroscopic bases auriculate, basiscopic bases truncate and often forming a (90°–) 100°–110° angle with rachis, apex acute, round but mucronate, acroscopic margins of pinnae repand and serrate, abaxially scaly, adaxially glabrous; microscales on abaxial surface subulate without dilated base (narrow-type microscales; cf. Fig. 1E), 0.1–0.23 mm, 0.05–0.1 mm wide at base; pinnae with the venation pinnate; midrib abaxially slightly raised, adaxially flat and invisible; lateral veins free, in 4 to 7 pairs from midrib per pinna, each lateral vein further dichotomous, indistinct on both surfaces. Sori terminal on veins of pinnae, (1 to)4 to 8 per fertile pinna (Fig. 1B), located between midrib and pinna margin, 0.7–2.2 mm distant from pinna margin; all pinnae on fertile lamina fertile; indusia peltate, 0.6–0.8 mm diam., membranous, brown, margin erose (Fig. 1F).

Spore morphology. The bilateral spores in *Polystichum normale* are circular in polar view and elliptic in equatorial view. The spore size is ca. 50.5 × 41.3 μm (polar axis × equatorial axis). The ratio of the length of the polar axis to that of the equatorial axis (P/E ratio) is ca. 1.22:1. The perispore sculpture is irregularly perforate, with a few ridges and numerous spinules (Fig. 2G) and is diagnostic for the new species. This contrasts with the reticulate sculpturing observed in *P. hancockii* (Chen, 2007, unpublished).

Distribution and ecology. As currently known, *Polystichum normale* is restricted to southern Chongqing, northeastern and southeastern Guizhou, as well as northwestern Hunan provinces in China. *Polystichum normale* grows in thick, acidic soils derived from sandstone. Populations were observed under forest cover or in shaded areas in valleys. Elevations of collected populations ranged from 600 to 1850 m.

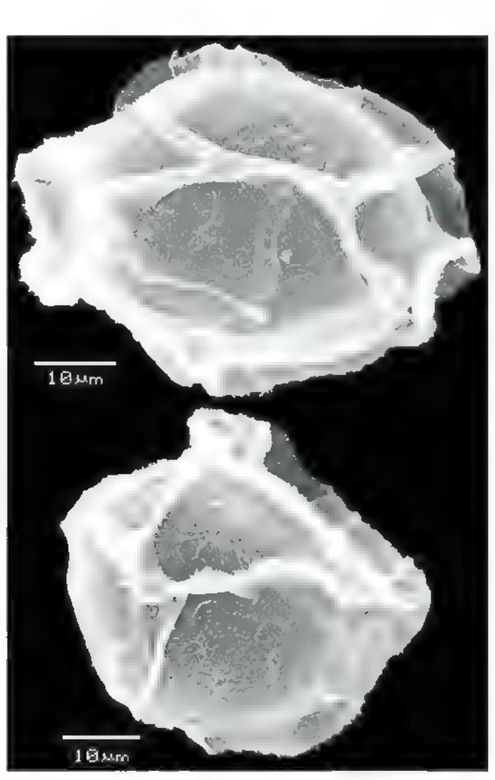
IUCN Red List category. There seem to be no serious concerns about the conservation status of *Polystichum normale*. The taxon has been found in many populations in a relatively wide range across three provinces in China. The core distribution areas, Mt. Fanjing (the type locality) and Mt. Leigong, are now well-protected national parks in Guizhou Province. The most recent collection dates back to 2007 from Mt. Fanjing (the type), although the population size was small, estimated at no more than 100 individuals scattered in a river valley. However, the geographical range of *P. normale* appears to be severely fragmented. The current status of the population collected in 1992 from Sandu County, Guizhou Province, of the population collected in 1979 from Chongqing Municipality, and finally of the population not re-collected since 1958 in Sangzhi County, Hunan, is currently unknown and its reduction in population size may be suspected. These populations should be under increasing threat of extinction as a result of known deforestation and human disturbance (Zhang & Wang, pers. obs.). Therefore, the status of *P. normale* is best classified as Vulnerable or VU, according to IUCN (2008) criteria.

Etymology. The epithet of the new species is taken from the Latin "normale," which refers to the completely green or nonvariegated coloration of the fronds.

Discussion. Our unpublished phylogenetic analysis based on chloroplast *trnL-F* sequences resolved *Polystichum normale* as sister to *P. tripteron*, with 97% jackknife support. In another independent phylogenetic analysis based on the chloroplast *rbcL* gene sequences, *P. tripteron* was resolved as sister to *P. hancockii* with 100% bootstrap support (Liu et al., 2007). These two independent studies suggest that *P. hancockii*, *P. normale*, and *P. tripteron* form a supported monophyletic clade. This clade corresponds to *Polystichum* sect. *Crucifilix* and is characterized by 1-pinnate lamina with a pair of 1-pinnate or pinnatifid (or simple) basal pinnae.

Morphologically, *Polystichum normale* is distinguished from *P. tripteron* by having toothed and oblong or almost rectangular pinnae with an acute apex and by having basal pinnae that are simple (Figs. 1, 2C, D), pinnatifid (Fig. 2B), or 1-pinnate (Fig. 2A). The basalmost pinnae are almost as long as (Fig. 1) to twice as long as the median pinnae (Fig. 2A). In contrast, *P. tripteron* has coarsely serrate and falcate-lanceolate pinnae with an acuminate apex and basal pinnae ca. six times as long as the median pinnae. *Polystichum tripteron* is widely distributed in China, Japan, the Korean Peninsula, and the Russian Far East.

Morphological differences between *Polystichum normale* and *P. hancockii* lie in that *P. normale* has the sori positioned closer to pinna margins and the indusia are larger, 0.6–0.8 mm in diameter, whereas *P. hancockii* has the sori slightly closer to the midrib, with the indusia only 0.3–0.4 mm. In addition, the basal pinnae of *P. normale* can be simple or pinnatifid or 1-pinnate, while those of *P. hancockii* are consistently 1-pinnate (at least some laminae on



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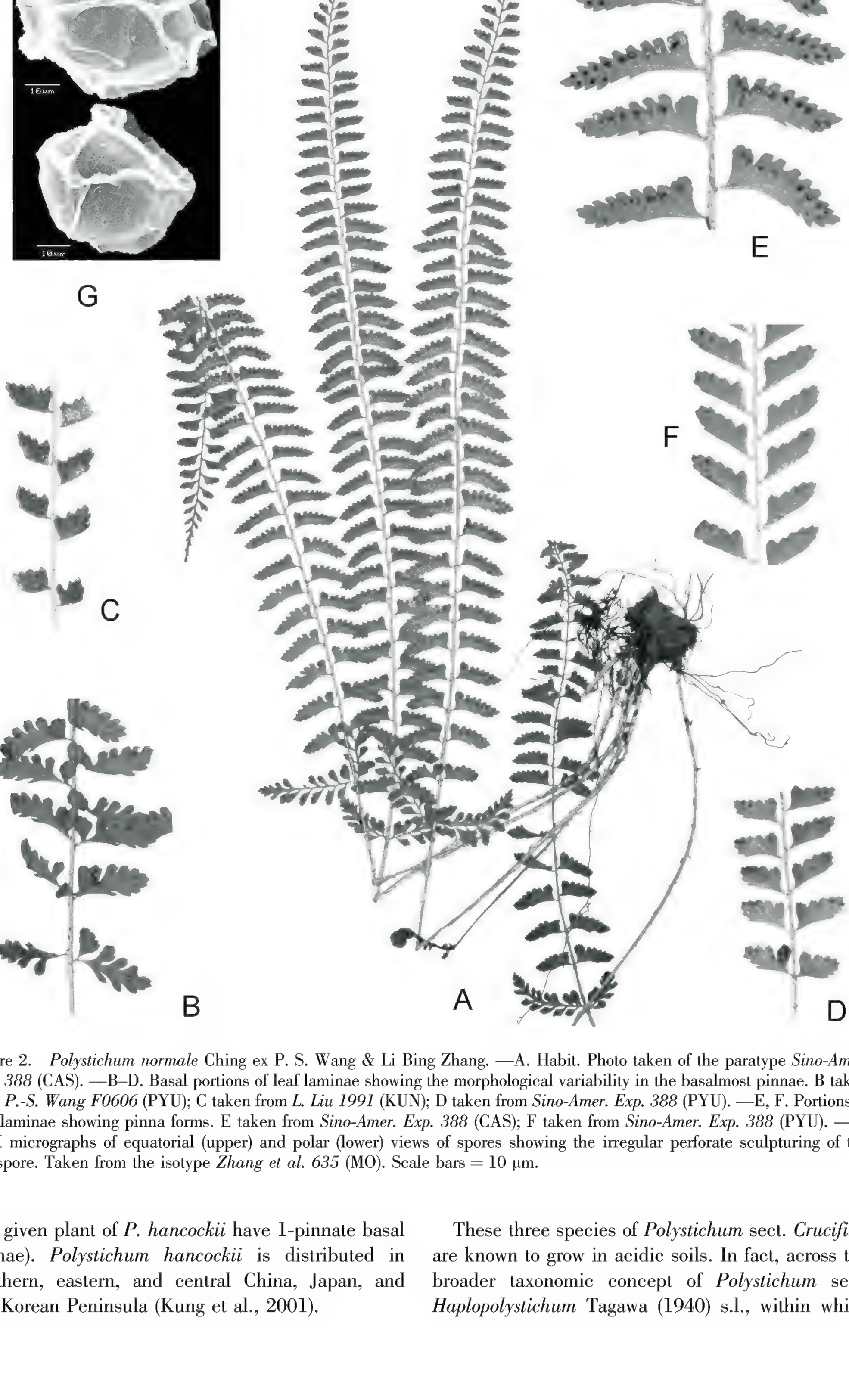

C

B

A

D

E

F

Figure 2. *Polystichum normale* Ching ex P. S. Wang & Li Bing Zhang. —A. Habit. Photo taken of the paratype *Sino-Amer. Exp. 388* (CAS). —B–D. Basal portions of leaf laminae showing the morphological variability in the basalmost pinnae. B taken from *P.-S. Wang F0606* (PYU); C taken from *L. Liu 1991* (KUN); D taken from *Sino-Amer. Exp. 388* (PYU). —E, F. Portions of leaf laminae showing pinna forms. E taken from *Sino-Amer. Exp. 388* (CAS); F taken from *Sino-Amer. Exp. 388* (PYU). —G. SEM micrographs of equatorial (upper) and polar (lower) views of spores showing the irregular perforate sculpturing of the perispore. Taken from the isotype *Zhang et al. 635* (MO). Scale bars = 10 μm.

any given plant of *P. hancockii* have 1-pinnate basal pinnae). *Polystichum hancockii* is distributed in southern, eastern, and central China, Japan, and the Korean Peninsula (Kung et al., 2001).

These three species of *Polystichum* sect. *Crucifilix* are known to grow in acidic soils. In fact, across the broader taxonomic concept of *Polystichum* sect. *Haplopolystichum* Tagawa (1940) s.l., within which

P. hancockii, *P. normale*, and *P. tripteron* affine, ca. nine species (Zhang & He, 2009a) are known to edaphically prefer acidic soils. Acidophiles in section *Haplopolystichum* s.l. include *P. balansae* Christ, *P. falcatilobum* Ching ex W. M. Chu & Z. R. He, *P. formosanum* Rosenst., *P. hookerianum* (C. Presl) C. Chr., *P. uniseriale* (Ching ex K. H. Shing) Li Bing Zhang, and *P. yaanense* Liang Zhang & Li Bing Zhang, in addition to the three species discussed herein for section *Crucifilix*. Additionally, *P. acutidens* Christ and *P. deltodon* (Baker) Diels are sometimes noted as tolerant of acidic soils. This contrasts with the 12 species occurring in basic soils and restricted to limestone areas as described in recent years (Wang & Wang, 1994, 1997, 2001; Zhang & He, 2009a, 2009b, 2010, 2012; He & Zhang, 2010, 2011; Zhang et al., 2010).

Polystichum normale is one of the morphologically most variable species in section *Haplopolystichum* s.l., sensu Zhang and He (2009a). Its pinna shape, marginal teeth, as well as the morphology of the basal pinnae, are quite variable (Fig. 2), but this variation seems continuous among those specimens seen. It could be hypothesized that this variability may correlate with the relatively broad distribution of *P. normale* across three provinces in south-central China as well as with the diverse habitats observed.

KEY TO SPECIES OF *POLYSTICHUM* SECT. *CRUCIFILIX*

1a. Pinnae coarsely serrate on margins, falcate-lanceolate in shape, apex acuminate .... *P. tripteron*
1b. Pinnae toothed on margins, oblong or almost rectangular, apex acute 2
2a. Basal pinnae commonly 1-pinnate (at least some laminae on a given plant have 1-pinnate basal pinnae); sori slightly closer to midrib; indusia 0.3–0.4 mm diam.; perispores with reticulate sculpture ..... *P. hancockii*
2b. Basal pinnae rarely 1-pinnate; sori closer to pinna margins; indusia 0.6–0.8 mm diam.; perispores with irregularly perforate sculpture ..... *P. normale*

Paratypes. CHINA. **Chongqing:** Qianjiang Co., Xinjian, Xiongjiagou, 750 m, 9 July 1979, *S.-x. Tan & C.-L. Li 735* (PYU). **Guizhou:** Jiangkou Co., Fanjing Shan, Tongkuangchang to Yu'ao, 800 m, 17 Oct. 1985, *P.-S. Wang F0638* (CDBI, HGAS, PYU, Herbarium Pei-Shan Wang); Heiwan River, 700 m, 16 Oct. 1985, *P.-S. Wang F0606* (CDBI, PYU, Herbarium Pei-Shan Wang); 27 Aug. 1986, *Sino-Amer. Exp. 388* (A, CAS, PYU); Daheiwan, 720 m, 16 Oct. 1985, *P.-S. Wang F0614* (HGAS); Leishan Co., Taoliang, 1030 m, 25 Apr. 1984, *P.-S. Wang & B. Liu 76941* (CDBI, Herbarium Pei-Shan Wang); Leigong Shan, 1850 m, 13 Mar. 1984, *B. Liu 300* (CDBI, Herbarium Pei-Shan Wang); Wudong, Xiangshuiyan, above Wei-Cheng Rd., 1130 m, 22 May 1965, *Z.-P. Jian, C.-Z. Dang, N.-G. Ye et al. 50150* (PE); Fangxiang, Pingxiang to Getou, 1060 m, 28 June 1965, *Z.-P. Jian, C.-Z. Dang, N.-G. Ye et al. 51037* (PE); Sandu Co., Lalan, 2 Apr. 1992, *F. Wang 407* (CDBI, Herbarium Pei-Shan Wang). **Hunan:** Sangzhi Co., Shadiping, Baheshe, 1152 m, on slope, 16 June 1958, *L. Liu 1991* (KUN, MO, PYU).

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Dryopteris liboensis (Dryopteridaceae), a New Species in *Dryopteris* sect. *Erythrovariae* from Guizhou, China

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ABSTRACT. *Dryopteris liboensis* P. S. Wang, X. Y. Wang & Li Bing Zhang, a new species of *Dryopteris* Adans. (Dryopteridaceae) from southern Guizhou, China, is described and illustrated. *Dryopteris liboensis* is assigned to *Dryopteris* subg. *Erythrovariae* (H. Ito) Fraser-Jenk. on the basis of its stiff and narrow petiole and rachis scales, but the new species is noteworthy within the section because these scales are not bullate. *Dryopteris liboensis* has stiff, narrowly lanceolate and filiform scales on the petiole and rachis and is therefore considered a member of the *D. erythrosora* (D. C. Eaton) Kuntze group of *Dryopteris* sect. *Erythrosoriae* H. Ito. It is unique among Chinese taxa of *Dryopteris* sect. *Erythrovariae* in having leaves 1- or 2-pinnate basally, with zero to three free lobes, and 1-pinnatifid at the blade apex.

Key words: China, Dryopteridaceae, *Dryopteris*, Guizhou, IUCN Red List.

Dryopteris Adans. (Dryopteridaceae) is one of the largest fern genera, with about 300 or more species worldwide (Lu, 1993). *Dryopteris* has been classified into four subgenera as *Dryopteris* subg. *Dryopteris*, *Dryopteris* subg. *Erythrovariae* (H. Ito) Fraser-Jenk., *Dryopteris* subg. *Nephrocystis* (H. Ito) Fraser-Jenk., and *Dryopteris* subg. *Pycnopteris* (Moore) Ching (Fraser-Jenkins, 1986), or three subgenera as *Dryopteris* subg. *Dryopteris*, *Dryopteris* subg. *Erythrovariae*, and *Dryopteris* subg. *Pycnopteris* (Wu & Lu, 2000). Of these, *Dryopteris* subg. *Erythrovariae* is one of the three subgenera recognized in both classifications. The circumscription of *Dryopteris* subg. *Erythrovariae* by Wu and Lu (2000), however, differs slightly from that of Fraser-Jenkins (1986). Fraser-Jenkins (1986) used overall morphological similarities to characterize *Dryopteris* subg. *Erythrovariae* and did include a few species without bullate scales. In contrast, Wu and Lu (2000) strictly used the presence of bullate scales to define *Dryopteris* subg. *Erythrovariae*. As a result of the differing circumscriptions, the taxonomic placement of a few species, e.g., *D. polita* Rosenst., has been controversial. A recent molecular analysis demonstrated that Fraser-Jenkins's (1986) definition of *Dryopteris* subg. *Erythrovariae* is more natural (Zhang et al., 2012).

In the summer of 2005, one of the authors (P.-S.W.) collected specimens of an unidentified species of *Dryopteris*. Additional material was collected in 2009 and 2010 from the same locality. This species is similar to members of *Dryopteris* subg. *Erythrovariae* in the shape of the petiole and rachis scales, but the scales are not bullate. The discovery of this species offered an opportunity to test the differing views of Fraser-Jenkins (1986) and Wu and Lu (2000).

Dryopteris liboensis P. S. Wang, X. Y. Wang & Li Bing Zhang, sp. nov. TYPE: China. Guizhou: Libo Co., Lihua, Wujia River, 25°21′1.71″N, 108°7′32.26″E, 520 m, on rock wall by river, 3 Aug. 2005, *P.-S. Wang 20052* (holotype, PYU; isotypes, CDBI, MO, Herbarium Pei-Shan Wang [Guizhou Institute of Biology]). Figure 1.

Diagnosis. *Dryopteris liboensis* P. S. Wang, X. Y. Wang & Li Bing Zhang is most similar to species of the *D. erythrosora* (D. C. Eaton) Kuntze group of *Dryopteris* sect. *Erythrosoriae* H. Ito in having narrowly lanceolate and filiform scales on the petiole base and rachis, but it differs from any species of this series in China by its leaves that are 1- or 2-pinnate basally, the lower pinnae with up to three pairs of free lobes only, rather than either 1-pinnate leaves or if 2-pinnate, then the leaves with more than 10 pairs of pinnules.

Terrestrial, evergreen, 13–26 cm tall; rhizomes 5–7 mm, erect or slightly ascending, together with petiole bases densely scaled, the scales brown, narrowly

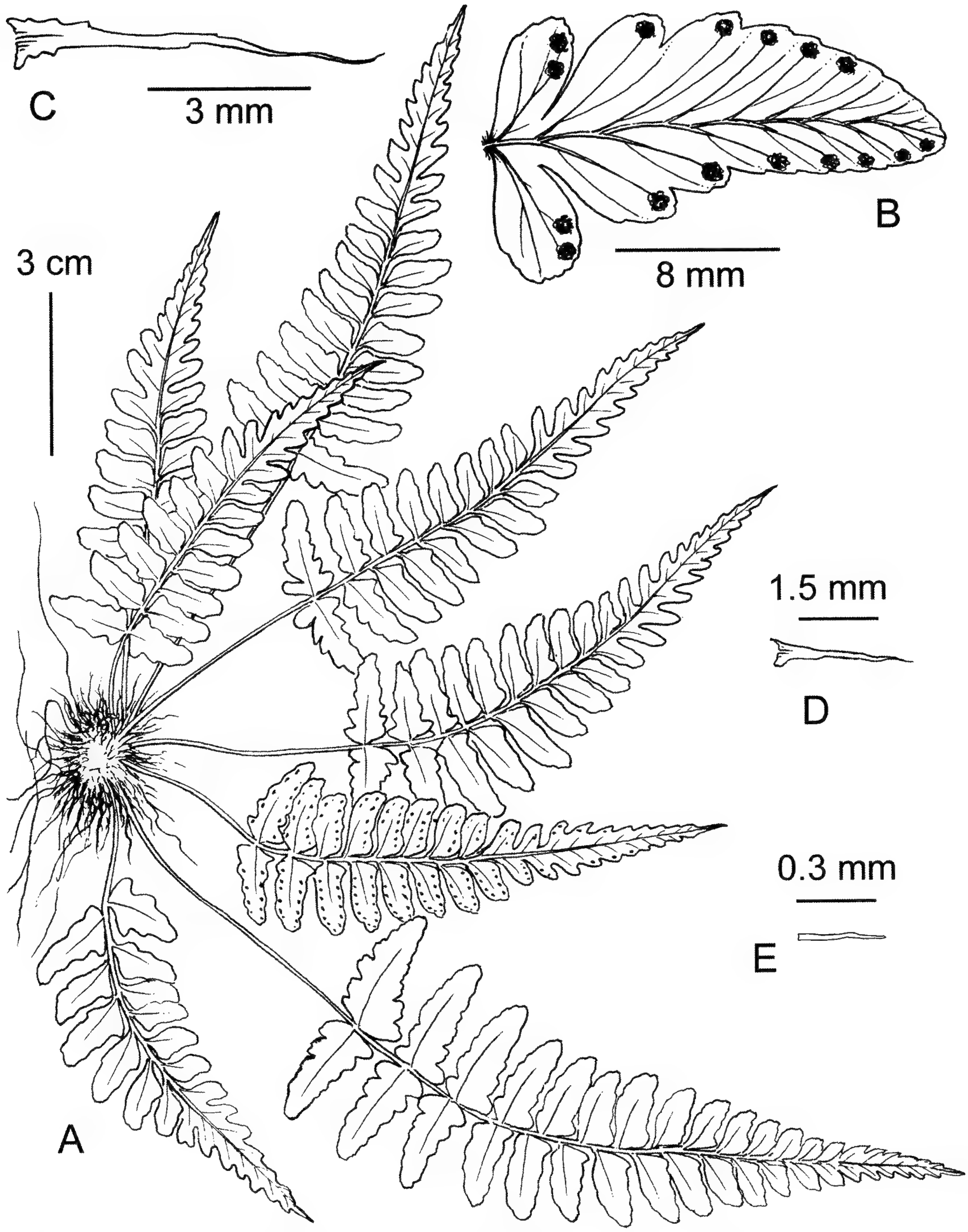

Figure 1. *Dryopteris liboensis* P. S. Wang, X. Y. Wang & Li Bing Zhang. —A. Habit. —B. Pinna. —C. Petiole scale. —D. Rachis scale. —E. Scale from lower leaf surface. Based on the isotype, *P.-S. Wang 20052* (CDBI).

lanceolate, 6–12 mm, 0.5–1.2 mm at base, stiff, not bullate, entire on margin, the scale apex filiform. Leaves caespitose; petiole brown at base and stramineous upward, thin but tough, adaxially sulcate, 4–14 cm, 0.5–1.5 mm diam., glabrate acropetally, with a tuft of stiff, narrowly lanceolate and filiform scales at base, these basal scales similar to those on rhizomes; leaf lamina narrowly deltate to narrowly ovate or lanceolate, 7–14 × 3–7 cm, cordate at base, acuminate at apex, 1- or 2-pinnate at frond base, 1-pinnatifid at apex; rachis

sulcate adaxially, 0.3–0.5 mm diam., sparsely scaled abaxially, the scales pale brown, narrowly lanceolate and filiform; pinnae chartaceous, in 5 to 12 pairs, short-stalked or sessile, alternate or opposite, often spreading, deltate to narrowly ovate, ± falcate, rounded or slightly cordate at base, obtuse at apex; largest pinnae near base, 1.4–3.5 × 0.8–1.8 cm, pinnatifid or with the basal pinnules sessile, the free lobes in 0 to 3 pairs; adaxially glabrous, abaxially glabrate, with a few narrowly lanceolate to linear microscales; pinna rachis 0.5–0.8 mm diam., slightly scaled abaxially; pinna lobes oblong, obtuse at apex, the margin incise-serrate; veins in lobes pinnately branched, the lateral veinlets often furcate. Sori round, 1 to 9 on each side of midrib of fertile pinnae, dorsal or nearly terminal on veinlets, close to pinna or blade margins; indusia peltate, brown, ca. 0.7 mm diam., persistent, lacerate on margin.

Distribution and habitat. *Dryopteris liboensis* was found only in Libo County in southern Guizhou, bordering northern Guangxi, China. It is possible that this species may also occur in adjacent areas in southern Guizhou and northern Guangxi. *Dryopteris liboensis* was collected from shady sandstone walls under a forest canopy by a river at an altitude of 520 m. The soil is acidic, which is the typical preference for most species of *Dryopteris*.

IUCN Red List category. Only one population at one locality with ca. 30 individuals was collected, although *Dryopteris liboensis* may be found elsewhere nearby. Based on the evidence available, *D. liboensis* should be classified as Critically Endangered (CR), according to the International Union for Conservation of Nature and Natural Resources guidelines (IUCN, 2008). Although the habitat of *D. liboensis* in Libo County is inside the Maolan Nature Reserve and thus is relatively well protected, further investigation of the species' population dynamics is needed to best assess its vulnerability.

Etymology. The epithet of the new species is taken from the Chinese pinyin, "libo," the name of the county in southern Guizhou, China, and the Latin suffix, "-ensis," meaning "of origin or place," referring to the type locality and known distribution of the species.

Discussion. It appears equivocal in which subgenus *Dryopteris liboensis* should be classified. Although the new species has no bullate scales, which is similar to species of *Dryopteris* subg. *Dryopteris*, *D. liboensis* is not taxonomically placed within *Dryopteris* subg. *Dryopteris*. The new species has a chartaceous leaf blade and a tuft of stiff, narrowly lanceolate and filiform scales at the petiole base, while the remainder of the petiole is glabrate. These features are reminiscent of members of *Dryopteris* subg. *Erythrovariae*. There are a few species in *Dryopteris* subg. *Erythrovariae* that are notable for the absence of bullate scales: *D. cyclopeltidiformis* C. Chr., *D. integriloba* C. Chr., *D. polita*, and *D. yenpingensis* C. Chr. & Ching ex Ching (Fraser-Jenkins, 1986). A preliminary molecular analysis based on chloroplast DNA sequences from *rbcL* and *trnL-F* loci does support *D. liboensis* as a member of *Dryopteris* subg. *Erythrovariae* and *Dryopteris* sect. *Erythrovariae* (Zhang et al., unpublished data). Accordingly, *D. liboensis* is the fifth member of *Dryopteris* subg. *Erythrovariae* known to lack bullate scales. *Dryopteris assamensis* (C. Hope) C. Chr. & Ching was reported as having no bullate scales (Fraser-Jenkins, 1986), but in fact, it does have bullate-based scales at the base of the pinna rachis and along the midribs of pinnules (Wu & Lu, 2000).

Among the species of *Dryopteris* sect. *Erythrovariae* in China, *D. liboensis* is unique in having leaves that vary from 1-pinnate or 2-pinnate on basal pinnae, to 1-pinnatifid at the frond apex. The lower pinnae have at most 3 pairs of free lobes or pinnules. There are five additional species in the *D. erythrosora* group in China, characterized by having narrowly lanceolate or linear, stiff, and entire petiole and rachis scales: *D. decipiens* (Hook.) Kuntze, *D. erythrosora* (Eaton) Kuntze, *D. fuscipes* C. Chr., *D. hondoensis* Koidz., and *D. ryo-itoana* Sa. Kurata. The six Chinese species of the *D. erythrosora* group can be distinguished from one another by the following key (modified from Wu & Lu, 2000).

KEY TO SPECIES OF THE *DRYOPTERIS ERYTHROSORA* GROUP FROM CHINA

1a. Leaves consistently 1-pinnate; pinnae serrate or deeply lobed on margin but lobes sessile .... *D. decipiens*
1b. Leaves 1- or 2-pinnate at frond base; pinnules short-stalked or sessile.
  2a. Leaves shorter than 28 cm; the lower pinnae with 0 to 3 pairs of free lobes or pinnules ..... *D. liboensis*
  2b. Leaves exceeding 30(50) cm; lower pinnae with more than 10 pinnule pairs.
    3a. Pinnules deltate or ovate, serrate or shallowly pinnatifid; pinnule apex obtuse.
      4a. Pinnules serrate; sori close to pinna midrib ..... *D. fuscipes*
      4b. Pinnules shallowly pinnatifid; sori close to pinnule margins ... *D. ryo-itoana*
    3b. Pinnules lanceolate, pinnatifid; pinnule apex acuminate.
      5a. Pinnules shallowly pinnatifid; pinna rachis and pinnule rachis densely set with bullate scales; indusia darkish red in center .... *D. erythrosora*

5b. Pinnules deeply pinnatifid; pinna rachis and pinnule rachis sparsely set with bullate scales; indusia light red in center ..... *D. hondoensis*

Paratypes. CHINA. **Guizhou:** Libo Co., Lihua, Wujia River, 25°21′1.71″N, 108°7′32.26″E, 520 m, 8 Aug. 2009, *J.-H. Zhao & N.-W. Zhao 404* (CDBI, GZTM), summer 2010, *J.-H. Zhao & N.-W. Zhao s.n.* (GZTM).

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Selaginella longistrobilina (Selaginellaceae), a New Species from Guizhou, China, and *Selaginella prostrata*, a New Combination and Its Lectotypification

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ABSTRACT. A new lycophyte species, *Selaginella longistrobilina* P. S. Wang, X. Y. Wang & Li Bing Zhang (Selaginellaceae), is described and illustrated from limestone hills in central Guizhou, China. *Selaginella longistrobilina* is most similar to *S. prostrata* H. S. Kung in the shape of the microphylls and in the arrangement, shape, and size of the sporophylls. However, the new species has longer strobili to 2.5 cm, and the sporophylls are often navicular adaxially, while *S. prostrata* has strobili only 3–4 mm, and the sporophylls are flattened adaxially. *Selaginella longistrobilina* is only known from central Guizhou, while *S. prostrata* is more widely distributed from Hunan, Sichuan to Yunnan in China. A new combination, *S. prostrata* (H. S. Kung) Li Bing Zhang, based on *Lycopodioides prostrata* H. S. Kung, is made and lectotypified herein.

Key words: China, Guizhou, IUCN Red List, *Selaginella*, Selaginellaceae.

When Professor Chu of Yunnan University prepared his treatment of Selaginellaceae for the *Flora Yunnanica*, he examined the material of *Selaginella prostrata* H. S. Kung from Guizhou, Sichuan, and Yunnan cited by Kung (1981). Chu (2006) noticed that specimens from northeastern Yunnan were similar to those from Sichuan, but that Guizhou collections represented an undescribed species distinguishable from *S. prostrata* in the morphology of the strobili, sporophylls, and microspores. Our investigation confirms Chu's (2006) observations, and the new species is described herein.

Selaginella longistrobilina P. S. Wang, X. Y. Wang & Li Bing Zhang, sp. nov. TYPE. China. Guizhou: Anshun City, on rocks and crevices on hill, 1500 m, 29 Oct. 1978, *P.-S. Wang 75606* (holotype, PYU; isotypes, CDBI, MO). Figure 1.

Diagnosis. *Selaginella longistrobilina* P. S. Wang, X. Y. Wang & Li Bing Zhang is most similar to *S. prostrata* (H. S. Kung) Li Bing Zhang, but the former has longer strobili to 2.5 cm and the sporophylls are often navicular adaxially, while the latter has strobili only 3–4 mm long and the sporophylls are flattened adaxially.

Plants to 15 cm; stems prostrate, 2.5–4 mm wide including microphylls, 1 to 4 times dichotomously branched; main stems branched throughout, stramineous, ca. 0.2 mm diam. in mid-portion, terete, slightly sulcate; lateral branches 6 to 10, simple or to 3 times dichotomously branched, branchlets 1–3 cm apart from each other; ultimate branches 2–3 mm wide including microphylls; rhizophores borne throughout. Microphylls dimorphous: lateral microphylls patent, ovate, 1.5–1.8 × 1–1.5 mm, base slightly cordate, apex mucronate or cuspidate, margins white, ciliate; median microphylls ovate, 0.8–1.3 × 0.4–0.7 mm, base rounded, apex shortly aristate, margins white, ciliate; axillary microphylls ovate to lanceolate, 0.7–1.5 × 0.3–0.5 mm, base rounded, apex acuminate, often disappearing with development of rhizophores at approximate positions. Strobili compact, dorsiventrally complanate, solitary or paired (forked), on terminal to lateral stems, 3–25 mm. Sporophylls located from below branching positions of ultimate branchlets upward, strongly dimorphic, non-resupinate, their arrangement, shape, and size same as or similar to those of trophophylls; ventral sporophylls sunken adaxially, broadly lanceolate, adaxially navicular, ca. 0.5 × 1.8 mm, base rounded, apex acuminate, margins ciliate; dorsal sporophylls broadly lanceolate to narrowly ovate, adaxially flattened, ca. 0.6 × 1.6 mm, base rounded,

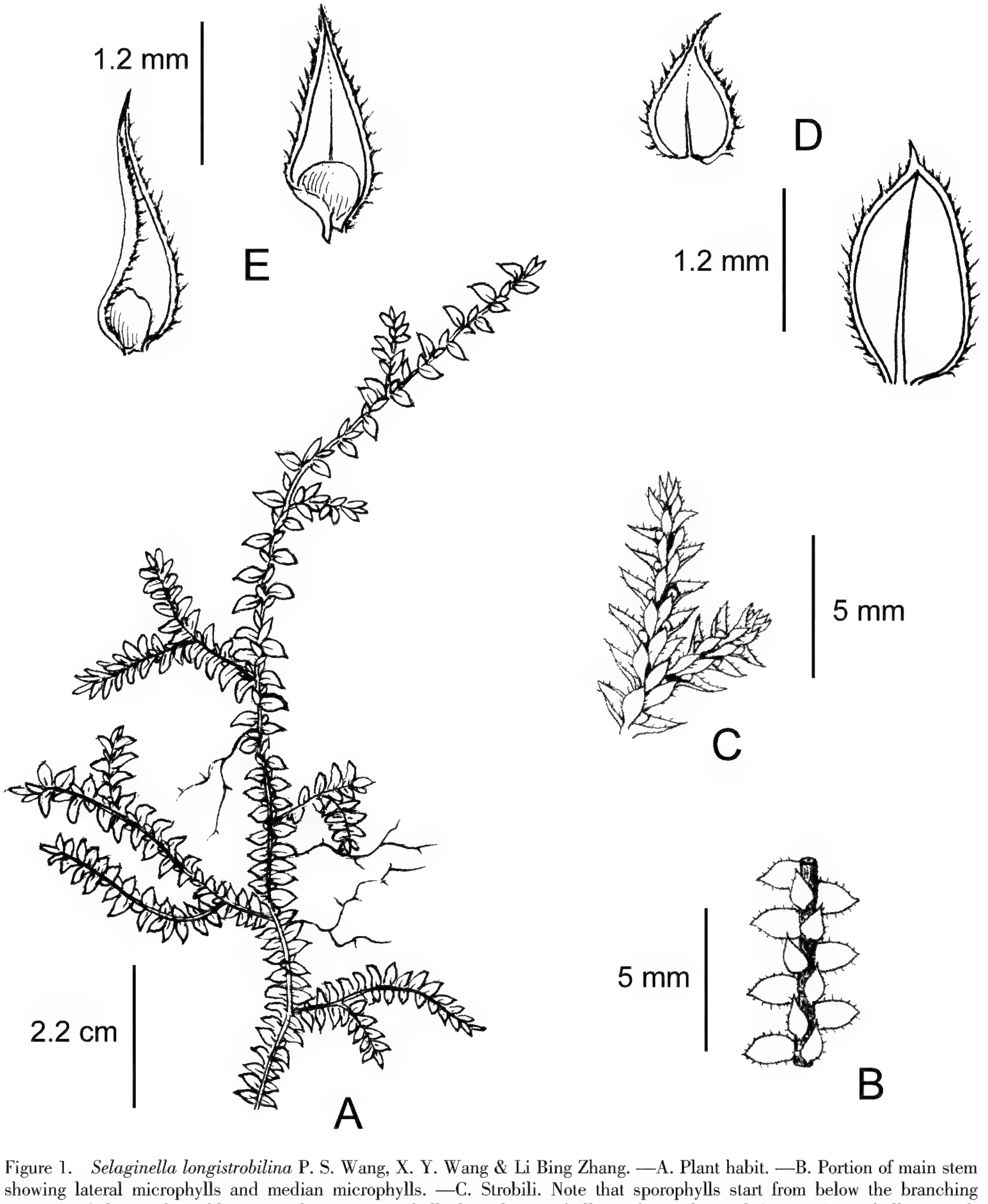

Figure 1. *Selaginella longistrobilina* P. S. Wang, X. Y. Wang & Li Bing Zhang. —A. Plant habit. —B. Portion of main stem showing lateral microphylls and median microphylls. —C. Strobili. Note that sporophylls start from below the branching positions of ultimate branchlets upward. —D. Microphylls, lateral microphyll at right, median at left. —E. Sporophylls, ventral, navicular sporophyll at left, with dorsal, flattened one at right. Based on the isotype, *P.-S. Wang 75606* (CDBI).

apex acuminate, margins ciliate. Macrosporangia 1 to 5, at basal portion of strobili, elsewhere with more than 15 microsporangia; microspores ocherous, the sculpturing verrucate with irregularly sized verrucae, the colpi twisted, usually not forked at ends, and reaching the equatorial plane of the spore; macrospores 4 in each macrosporangium, light orange.

Distribution and habitat. *Selaginella longistrobilina* is currently known only from Anshun City in central Guizhou, China. It is possible that this species also occurs in adjacent similar areas in central Guizhou. *Selaginella longistrobilina* was collected from the weathered crust of limestone rocks and among crevices under secondary mixed forests on

a hill at an elevation of 1500 m. The soil at the type location was of a basic pH.

IUCN Red List category. Only two populations of *Selaginella longistrobilina* were observed at the type locality, with fewer than 20 individuals in total found. The new species might occur elsewhere in a nearby similar habitat. Based on the best evidence available, this taxon can be classified as Critically Endangered (CR) according to IUCN Red List criteria (IUCN, 2008).

Etymology. The epithet of the new species is taken from the Latin prefix, "longi-," meaning "long," and the Latin "strobilina," meaning "of the strobilus," which refers to the long strobili.

Discussion. *Selaginella longistrobilina* has been confused with *S. prostrata* (H. S. Kung) Li Bing Zhang (comb. nov.; see below) since the publication of the basionym of the latter, *Lycopodioides prostrata* H. S. Kung (Kung, 1988; Wang & Wang, 2001). When describing a taxon identified as "prostrata" (Kung, 1981; the name not validly published; see later discussion), Kung (1981) cited three gatherings from Guizhou, Sichuan, and Yunnan, which included both taxa. Specimens from Sichuan and Yunnan do correspond with Kung's "prostrata" (Chu, 2006), while the collection from Guizhou is selected herein as the type of the newly described *S. longistrobilina*.

Both taxa are indeed similar to each other in the shape of the microphylls and also share other similarities in the arrangement, shape, and size of the sporophylls. However, the two taxa do differ in the morphology of their strobili, sporophylls, sculpturing of spores, and colpi of microspores as noted by Chu (2006). *Selaginella longistrobilina* often has strobili to 2.5 cm and its sporophylls are located from below branching positions of ultimate branchlets upward. The larger sporophylls are adaxial and clearly navicular. Microspores have verrucate sculpturing with irregularly sized verrucae; the colpi of microspores are twisted, usually not forked at the ends, and they reach the equatorial plane of the spore. Irregularly verrucate sculpturing of the microspores is common among species of *Selaginella* P. Beauv. In contrast, *S. prostrata* has shorter strobili, to only 3–4 mm, and the sporophylls are located only at the termini of ultimate branchlets. Its sporophylls are flattened adaxially, with only a few of the upper, adaxial sporophylls slightly navicular. The microspores are tuberculate with regularly sized tubercules; the microspore colpi are straight, forked at the ends, and do not extend to the equatorial plane.

Paratype. CHINA. **Guizhou:** Anshun City, on rocks & crevices on hill, 1500 m, 24 June 1978, *P.-S. Wang 75550* (PYU, Herbarium Pei-Shan Wang [Guizhou Institute of Biology]).

Selaginella prostrata (H. S. Kung) Li Bing Zhang, comb. nov. Basionym: *Lycopodioides prostrata* H. S. Kung, Fl. Sichuan. 6: 76, pl. 20, parts: 7–11. 1988. [Latin diagnosis & description in Kung, Acta Bot. Yunnan. 3: 254. 1981.] TYPE. China. Sichuan: Emei Shan, Jiushijiudaoguai, Shouxingqiao, 4 July 1955, *X.-J. Zheng 30071* (lectotype, designated here, PE; isolectotype, SZ not seen).

Discussion. When Kung (1981: 254) described his *Selaginella prostrata*, he cited three gatherings: *X.-J. Zheng 30071* from Sichuan, *NE Yunnan Exp. 808* (KUN not seen, PE, PYU not seen) from Yunnan, and *P.-S. Wang 75606* (CDBI, MO, PYU, Herbarium Pei-Shan Wang [Guizhou Institute of Biology]) from Guizhou, but he failed to designate one collection as type, as noted by Chu (2006). Therefore, this name was not validly published by Kung in 1981, following the *International Code of Botanical Nomenclature* (McNeill et al., 2006, Art. 37.1).

Later, Kung (1988: 76) made a new combination, "*Lycopodioides prostrata* (H. S. Kung) H. S. Kung," based on his 1981 invalid name in *Selaginella*. Kung (1988: 76) implicated one of the three gatherings cited in Kung (1981) as the type, *X.-J. Zheng 30071* from Emei Shan in Sichuan, by stating that "the type was collected from Emei Shan" in Chinese. This type designation, together with Kung's (1988: 76) reference to the previously and effectively published Latin description and diagnosis by him (Kung, 1981: 254), validated the publication of *L. prostrata* H. S. Kung (1988) as a new species (McNeill et al., 2006: Art. 36.1) instead of a new combination or the name *S. prostrata* H. S. Kung, which Kung (1988) did not intend to publish. Article 37.7 does not apply, since the specific deposit of the type was not required by the *Code* until 1990. The herbarium of deposit for the type of *L. prostrata* was not indicated by Kung (1988). There are two specimens known to us for *X.-J. Zheng 30071*, which are deposited at PE and SZ, and herein we designate the specimen at PE as lectotype. We were able to confirm the taxonomic identity of the PE sheet, but did not see the SZ specimen, and thus the better known PE specimen is chosen.

Acknowledgments. We thank Wei-Ming Chu of Yunnan University for initially noticing and summarizing the differences between *Selaginella longistrobilina* and *S. prostrata*. We thank Faqiang Lü

for the line drawing, and two anonymous reviewers, Victoria Hollowell, Roy Gereau, and Nick Turland for helpful comments. We thank the curators of the herbaria CDBI, MO, PE, and PYU for providing access to the material in their care.

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NOVON

Ocotea grandifructa (Lauraceae), a Novelty from the Brazilian Atlantic Forest

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Abstract. In this taxonomic contribution, a new species of Lauraceae, *Ocotea grandifructa* L. C. S. Assis & M. F. Santos, from the Brazilian Atlantic forest in Minas Gerais State, is presented. Following the diagnostic criterion for species delimitation, in which a species is delimited by an exclusive feature or an exclusive combination of morphological features, the new species differs from other dioecious species in *Ocotea* Aubl. by presenting branchlets with rhythmic growth, chartaceous leaf laminas, deciduous perianth at fruit maturity, cupules with a single margin, and large, ovoid fruits.

Resumo. Nesta contribuição taxonômica, uma espécie nova de Lauraceae, *Ocotea grandifructa* L. C. S. Assis & M. F. Santos, é descoberta na floresta atlântica brasileira, no Estado de Minas Gerais. Seguindo o critério diagnóstico para a delimitação de espécies, no qual uma espécie é delimitada por uma característica exclusiva ou uma combinação exclusiva de características morfológicas, a espécie nova difere-se das outras dióicas em *Ocotea* Aubl. por apresentar ramos com crescimento rítmico, lâminas cartáceas, um perianto decíduo na maturidade dos frutos, cúpulas com uma única margem e frutos grandes, ovóides.

Key words: Atlantic forest, Brazil, IUCN Red List, Lauraceae, Minas Gerais, *Ocotea*.

Ocotea Aubl., the largest Neotropical genus of Lauraceae, comprises ca. 300 to 350 species in the Neotropics plus ca. 50 to 60 species in Africa and Madagascar (Rohwer, 1993; Madriñán, 2004a). The genus is highly diversified in the Neotropical lowlands and montane forests (Rohwer, 1986, 1993; Madriñán, 2004a). Its polyphyly has been confirmed by molecular phylogenetic analyses (Chanderbali et al., 2001). However, a new classification as an expression of the phylogenetic relationships has not yet been achieved. *Ocotea* is not taxonomically well defined, but the species have been characterized by stamens with four pollen sacs arranged in two horizontal pairs and flowers with free perianth, which generally lacks papillae on the adaxial side (Rohwer, 1986; van der Werff, 1991, 2002). In this taxonomic contribution, a new dioecious species of Lauraceae, *O. grandifructa* L. C. S. Assis & M. F. Santos, discovered from the Brazilian Atlantic forest, is described.

As defined here, flower length includes the pedicel. Vegetative and reproductive terminology follow Radford et al. (1974), Hallé et al. (1978), Weberling (1992), Rohwer (1993), and Assis and Mello-Silva (2010a, 2010b). Branchlets with short internodes and cataphylls surrounding buds and inflorescences are associated with rhythmic growth, which can be characterized by its periodicity and by the leaves distinctly clustered at the tip and/or middle of the branchlets (Hallé et al., 1978; Assis & Mello-Silva, 2010b). The androecium of *Ocotea* is composed of four whorls, each one with three elements (Rohwer, 1993). Whorls I and III are

opposite to the outer whorl of the perianth, whereas whorls II and IV are opposite to the inner whorl of the perianth. Whorl IV is staminodial or absent. Scanning electron microscopy of the floral organs, obtained from herbarium specimens, was made using a Carl Zeiss DSM 970 microscope (Oberkochen, Germany). The species delimitation is based on the taxonomic (diagnostic) criterion, in which a species is delimited by an exclusive feature or an exclusive combination of morphological features (de Queiroz, 2007; Schuh & Brower, 2009; Assis, 2011). Geographic distribution and habitat complement species circumscription. The classification of the Brazilian Atlantic forest follows Veloso et al. (1991), as modified by Oliveira-Filho and Fontes (2000).

Ocotea grandifructa L. C. S. Assis & M. F. Santos, sp. nov. TYPE: Brazil. Minas Gerais: Itambé do Mato Dentro, Distrito Santana do Rio Preto (Cabeça de Boi), Área de Proteção Ambiental (APA) do Parque Nacional da Serra do Cipó, interior da Mata do Cachoeirão, 19°25′54.7″S, 43°25′58.3″W, 25 Oct. 2008 (♀ fl., fr.), *M. F. Santos & J. B. C. Marques 423* (holotype, SPF; isotype, MO). Figures 1, 2.

Diagnosis. *Ocotea grandifructa* L. C. S. Assis & M. F. Santos differs from the other dioecious species of *Ocotea* Aubl. by presenting branchlets with rhythmic growth, chartaceous leaf laminas, deciduous perianth at fruit maturity, cupules with a single margin, and large, ovoid fruits ca. 3.6 × 3.1 cm.

Trees 8–10 m tall, dioecious; branchlets with shortened to irregularly arranged internodes, young branchlets terete to applanate, black, glabrous, older branchlets terete to applanate, gray to brown, glabrous; buds glabrous; leaves clustered at the tips and middle of the branchlets, internodes 0.1–5 cm. Leaves with petioles 6–13 × 1–2 mm, half-terete; lamina 7.5–16.7 × 2.1–5.6 cm, chartaceous, plane, elliptic to narrowly elliptic, rarely obovate, base acute, apex acuminate, rarely acute to rounded, adaxial and abaxial sides green to black, glabrous, venation raised, secondary veins in 6 to 10 pairs, domatia absent. Cataphylls 4–10 × 1–3 mm, adaxial and abaxial surfaces glabrous, apex pubescent. Staminate inflorescences 2.5–10 cm, thyrsoid, at the axils of cataphylls, peduncles waxy, glabrous. Staminate flowers 3–4 mm; pedicels 1–1.5 mm or absent; receptacle 1–1.5 × 1–1.5 mm, outer and inner surfaces glabrous; perianth ca. 2.5 × 2 mm, ovate, adaxially with sparse pubescence, abaxially glabrous, apex glabrous to pubescent; androecium with 9 stamens (whorls I, II, and III), whorls I and II ca. 2 mm, filaments ca. 1 mm, glabrous, anthers ca. 1 mm, ovate, apex rounded to obtuse, glabrous, with upper and lower pollen sacs introrse; whorl III ca. 2 mm, filaments ca. 1 mm, glabrous, anthers ca. 1 mm, narrowly ovate, apex rounded, with upper pollen sacs latrorse and lower pollen sacs latero-extrorse; one pair of globose glands paired at the base of the whorl III stamens; staminodia (whorl IV) 3 or absent, ca. 1 mm, filiform, glabrous; pistillode glabrous, with ovary ca. 1 mm; style ca. 1 mm; stigma trilobed. Pistillate inflorescences 3–7.5 cm, thyrsoid, at the axils of cataphylls, peduncles waxy, glabrous. Pistillate flowers 3–4 mm; pedicels 0.5–1.5 mm; receptacle 1–1.5 × ca. 1.5 mm, adaxially and abaxially glabrous; perianth ca. 2.5 × 2 mm, ovate, adaxially with sparse pubescence, abaxially glabrous, apex glabrous to pubescent; androecium with 12 staminodia (whorls I, II, III, and IV), whorls I, II, and III similar to the stamens but smaller; whorl IV filiform; pistil glabrous, with ovary ca. 1.5 mm; style ca. 1 mm; stigma slightly trilobed. Cupules 0.8–1 × ca. 1 cm, obumbonate, striate, margin single and entire, perianth deciduous at fruit maturity; fruits ca. 3.6 × 3.1 cm, ovoid.

Distribution and habitat. *Ocotea grandifructa* is only known from the district of Santana do Rio Preto, municipality of Itambé do Mato Dentro, in the state of Minas Gerais, Brazil. The area is localized on the eastern side of the southern portion of the Serra do Espinhaço (Saadi, 1995), in the locality of Serra do Cipó, and is surrounded by the Rio Preto and its tributaries, which are part of the Rio Doce basin. In this area, the new species occurs in the Atlantic lower montane, semideciduous forest, which is distributed along the slopes and adjacent areas surrounding the Rio Preto, at an elevation of 1000 m. This area constitutes the western limit of the Atlantic forest in this region. The Serra do Espinhaço is mostly covered by the campos rupestres, which are part of a typically xeromorphic vegetation, growing on shallow quartzitic, oligotrophic soils above 1000 m, with a marked dominance of certain families of monocotyledons, such as the Eriocaulaceae, Velloziaceae, and Xyridaceae (Giulietti et al., 1987, 1997). Nevertheless, in places where other lithologies occur, a deep and mesotrophic soil can be formed, thus allowing the establishment of large forests, as in the area in which *O. grandifructa* occurs (Almeida-Abreu et al., 2005). Today, these forests are very disturbed due to human actions.

IUCN Red List category. *Ocotea grandifructa* is known from a single locality in Minas Gerais, without a conservation status. Following the IUCN Red List, it is considered Critically Endangered, or CR B1a (IUCN, 2001).

Phenology. *Ocotea grandifructa* has been observed with flowers and fruits in October.

Figure 1. Holotype of *Ocotea grandifructa* L. C. S. Assis & M. F. Santos. The insert at the upper right corner includes the cupule and fruit. Scale bar = 1 cm (*M. F. Santos & J. B. C. Marques 423*, SPF).

Etymology. The specific epithet refers to the large fruits, which are unusual among the *Ocotea* from the Brazilian Atlantic forest.

Relationships. *Ocotea grandifructa* has a particular morphology among the dioecious species of *Ocotea*, and it is difficult to compare it with a single similar species. Basically, it differs from the majority of these species by its branchlets with rhythmic growth, in which the length of the internodes, from the bottom to the tip of the branchlets, ranges

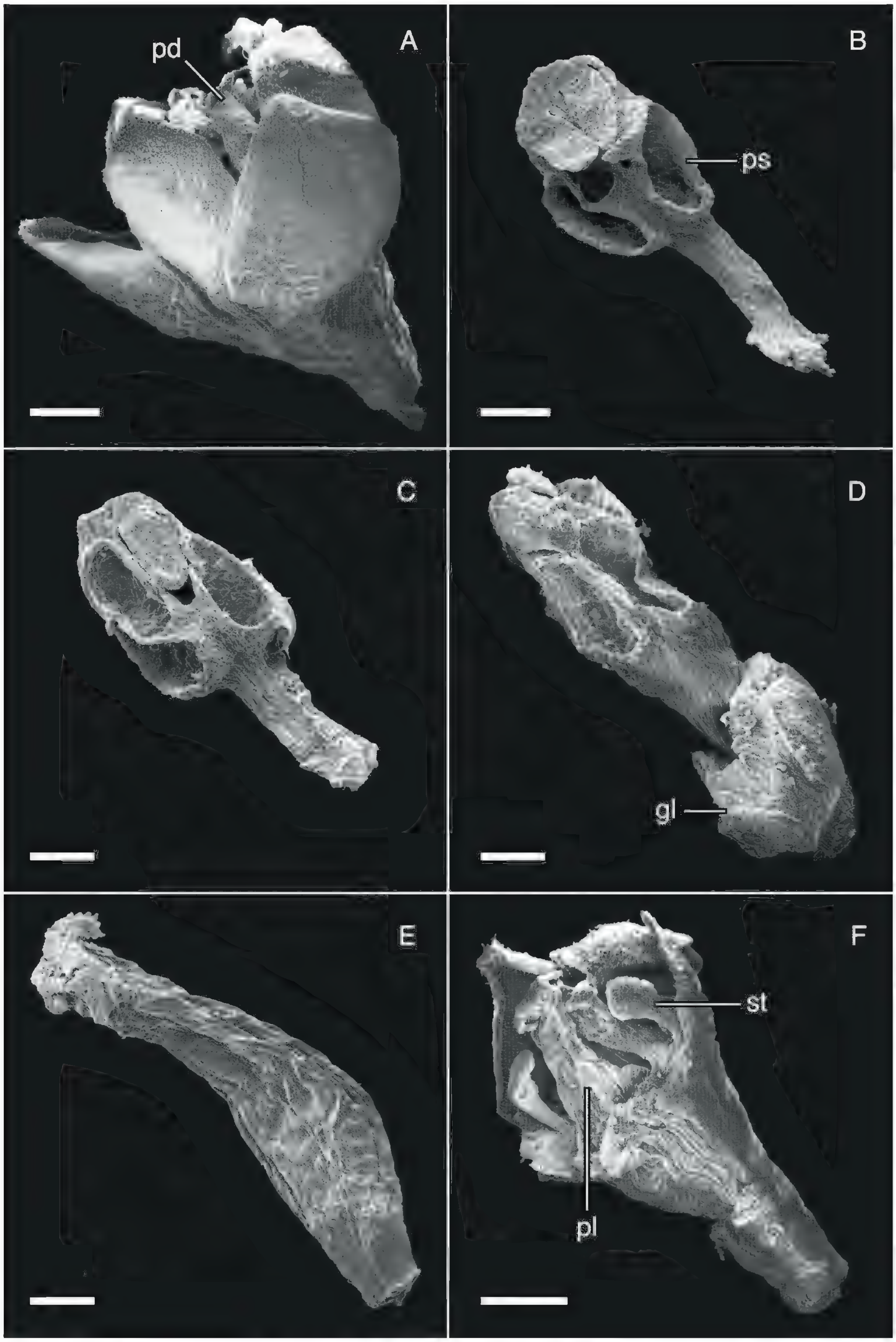

Figure 2. *Ocotea grandifructa* L. C. S. Assis & M. F. Santos. —A. Staminate flower. —B. Adaxial surface of stamen from whorl I. —C. Adaxial surface of stamen from whorl II. —D. Abaxial surface of stamen from whorl III. —E. Pistillode. —F. Pistillate flower. A–E taken from the paratype *M. F. Santos & J. B. C. Marques 415* (SPF); F from the holotype *M. F. Santos & J. B. C. Marques 423* (SPF). Abbreviations: gl = gland; pd = pistillode; pl = pistil; ps = pollen sac; st = staminodium. Scale bars for A and F = 500 μm; scale bars for B–E = 200 μm.

between 0.1 and 5.0 cm. Such a branchlet pattern is also observed in other dioecious species, such as *O. perrobusta* (C. K. Allen) Rohwer and *O. venosa* Gleason, both from the tepuis summits in Venezuela at 2000 m elevation. However, *O. grandifructa* can be distinguished from *O. perrobusta* by its chartaceous leaf laminas (vs. coriaceous), with the apex acuminate, rarely acute to rounded (vs. rounded), the cupules obumbonate (vs. hemispherical), and a perianth that is deciduous at fruit maturity (vs. persistent). *Ocotea grandifructa* can be distinguished from *O. venosa* by its chartaceous laminas (vs. coriaceous), with the base acute (vs. rounded to obtuse), the apex acuminate, rarely acute to rounded (vs. rounded, obtuse to acute), and longer petioles (6–13 mm vs. 1–2 mm). Species of the *O. indecora* [(Schott) Meisn. ex Mez] group, predominantly distributed in the Brazilian Atlantic forest, also have branchlets with rhythmic growth, but these are mostly hermaphroditic taxa/trees (Rohwer, 1986; Assis & Mello-Silva, 2009, 2010a, 2010b, 2010c). Branchlets with rhythmic growth are also seen in some species of the Neotropical dioecious genera *Endlicheria* Nees and *Rhodostemonodaphne* Rohwer & Kubitzki (Lauraceae), but these differ from *Ocotea* by both number and arrangement of pollen sacs, respectively (van der Werff, 1991; Rohwer, 1993; Chanderbali, 2004; Madriñán, 2004b). As previously noted, the rhythmic growth is associated with the presence of cataphylls surrounding buds and inflorescences. Nonetheless, cataphylls may also be found in species of Lauraceae that have continuous growth, including some species of *Endlicheria* (Chanderbali, 2004), *Rhodostemonodaphne* (Madriñán, 2004b), *O. lancifolia* (Schott) Mez, and *O. nutans* (Nees) Mez. The two latter species, like *O. grandifructa*, occur in the Brazilian Atlantic forest. *Ocotea grandifructa* differs from them by its cupules with a single margin (vs. double in *O. lancifolia*) and deciduous perianth at fruit maturity (vs. persistent in *O. nutans*). In addition to the differences indicated above, the large fruits of *O. grandifructa* are unusual among the dioecious species of *Ocotea* from the Brazilian Atlantic forest.

Paratype. BRAZIL. **Minas Gerais:** Itambé do Mato Dentro, Distr. Santana do Rio Preto (Cabeça de Boi), Área de Proteção Ambiental (APA) do Parque Nac. da Serra do Cipó, Mata do Cachoeirão, na borda, 19°25′54.7″S, 43°25′58.3″W, 25 Oct. 2008 (♂ fl.), *M. F. Santos & J. B. C. Marques 415* (BHCB, K, SPF).

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Erigeron pacalis (Asteraceae), a New Species from Western Canadian Boreal Grasslands

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Abstract. *Erigeron pacalis* Björk (Asteraceae) is a new species found only in the Peace River Grasslands of northeastern British Columbia, Canada. Its characteristics (short stature, leathery leaves, vestiture of mixed glandular and nonglandular hairs, and white rays) distinguish it from *E. glabellus* Nutt. and *E. asper* Nutt., the latter of which has appeared only in synonymy under *E. glabellus* according to most recent authors, but which shows consistent distinctions that merit its resurrection from synonymy.

Key words: Asteraceae, British Columbia, Canada, *Erigeron*, IUCN Red List, Peace River Lowlands.

The Peace Grasslands occupy a region of northeast British Columbia and northwest Alberta, Canada, that is contrastively dry and warm compared to surrounding boreal regions. These grasslands occupy a narrow corridor of south-facing slopes over the Peace River and its tributaries, and are surrounded by a vast plain vegetated by boreal forest. The finding of an undescribed and endemic species of *Erigeron* L. may be considered improbable given the presumed glacial history of the landscape; the Peace River Valley fits within the region that is thought to have been covered by continental ice sheets in the last glacial maximum. The grassland vegetation of the Peace Grasslands presumably formed in its current composition after the retreat of the Cordilleran and Laurentide ice sheets about 12,000 BP (Pielou, 1991). However, it remains to be determined definitively whether these two ice sheets joined, if a corridor remained vegetated and ice free between them throughout the last glacial maximum, or whether the corridor was closed but contained nunataks isolated on peaks of the foothills nearby (Pielou, 1991). Ice-free nunataks may not have harboured grassland species in the Peace River Lowlands, where *E. pacalis* Björk occurs, but nunataks on peaks of the eastern Rocky Mountain foothills may have served in this role. Even if the Peace Grasslands are vegetated entirely with species that arrived after the end of the glacial maximum, it cannot be ruled out that endemic plants have evolved there since that time, or have evolved in grasslands beyond the glacial-maximum limits of ice cover to the north or south where they subsequently became extirpated. Some regionally endemic vascular plants occupy landscapes that are thought to have been fully engulfed by ice sheets during the last glacial maximum, including a suite of vascular plant taxa known only from sand dune ecosystems near the southern shore of Lake Athabasca in northern Saskatchewan, Canada, around 59°N 109°W (Karpan & Karpan, 1998), and the moss family Pseudoditrichaceae Steere & Iwatsuki known only from Great Bear Lake, Northwest Territories, Canada. The Peace Grasslands are known to harbour endemic species, including a number of butterfly taxa (Guppy & Shepard, 2001), as well as additional vascular plants that await publication new to science (Björk, pers. obs.).

Erigeron pacalis Björk, sp. nov. TYPE: Canada. British Columbia: Peace Lowlands, Peace River Valley, 18 km W of Fort St. John, 460 m, 56°14.700′N 121°8.480′W, 18 July 2008, fl., *C. Björk 115790* (holotype, UBC). Figure 1.

Species nova ab *Erigeronte glabello* Nutt. statura humiliore, foliis coriaceis, capitulo in quoque caule semper unico, caulibus distaliter et involucro minute glanduliferis atque floribus radii discique brevioribus.

Plants perennial, forming small clumps; caudex branches 2–3 mm thick; roots fibrous; stems simple, 5–7 cm, erect or decumbent, strongly reddish purple pigmented and glabrous proximally, green, hirsute to hirsuto-villous and minutely glandular distally. Basal leaves ascending; petioles strongly reddish purple, ciliate, with stiffly spreading or antrorsely curved hairs 0.25–1.2 mm, intermixed with shorter, finer, ascending hairs; leaf blades entire, coriaceous, narrowly oblanceolate, 40–60 × 4–6 mm, often reddish purple blushed, 3-nerved or those of the narrower leaves 1-nerved or obscurely 3-nerved; lateral nerves less prominent than the middle nerve; apex rounded or blunt, often with short, indurate, yellowish mucro; both faces minutely strigillose or glabrate, eglandular, hairs 0.05–0.2 mm; leaf margins with larger, stiffer antrorse hairs; cauline leaves 4 to 7, gradually reduced distally,

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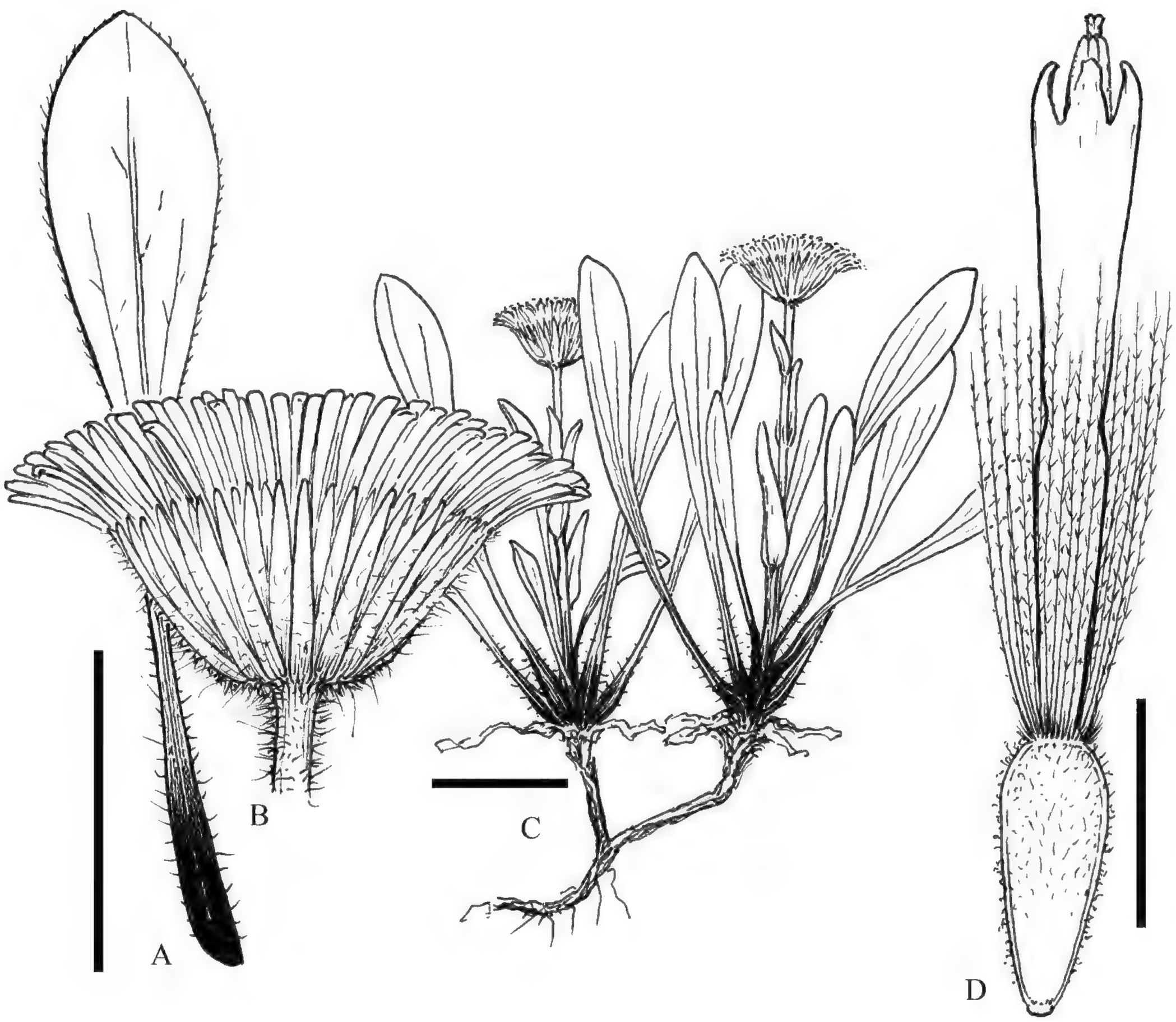

Figure 1. *Erigeron pacalis* Björk. —A. Basal leaf. —B. Flower head. —C. Plant habit. —D. Disc floret and immature cypsela. Scale bars: A, B = 10 mm, C = 20 mm, D = 1 mm. Drawn from the holotype *C. Björk 115790* (UBC).

proximal leaves spreading, distal leaves appressed to the stem; leaf blades lanceolate, mostly clasping at the base, 9–31 × 2–3 mm, ciliate proximally with stiffly spreading or antrorsely curving hairs, both faces minutely strigillose, distalmost leaves minutely glandular on both faces. Heads 1 per stem, not or scarcely exceeding the basal leaves; involucres 5–5.5 × 12–13.5 mm (pressed); phyllaries in 3 to 4 subequal to unequal series, linear-(ob)lanceolate, acuminate, 1-nerved, most with margins narrowly scarious, spreading-hirsute with septate hairs 0.2–0.6 mm, most hairs with 3 to 9 septa, with an underlayer of minute glandular hairs at least distally. Ray florets white, ca. 75 to 100 in number, 5–6 × 0.3–0.5 mm, not curling; disc florets 2.8–3.5 mm, papery, without distinct ribs, lobes narrowly triangular, erect or incurved. Cypselae ca. 2.2 × 0.5 mm, obscurely 2-nerved, strigillose, shorter hairs gland-tipped; pappus antrorsely barbellulate of 2 series of unequal members, ca. 30 outer setae, ca. 0.3 mm, and 16 to 18 inner setae, 2.5–3 mm.

Distribution and ecology. *Erigeron pacalis* is known only from the type locality near Fort St. John in northeastern British Columbia. It occupies boreal grasslands, a geographically rare biome occurring in North America only along east–west-oriented river valleys and in orographic rain shadows in the western boreal zone in British Columbia, Alberta, and the Yukon in Canada, and in Alaska in the United States. The boreal grasslands of the Peace River Valley are located on south-facing slopes along the Peace River between ca. 117° and 122° W. The nearest sizeable grasslands are approximately 200 km distant to the southeast in Alberta. In the Peace River Valley region, *E. pacalis* grows in patches of open grassland within a boreal forest mosaic. The local soils are fine textured, mixed with gravel and derived from poorly consolidated, calcareous sediment layers. *Erigeron pacalis* occurs with a variety of grasses and upland *Carex* L., as well as a large assortment of forbs and shrubby species in patchy grasslands in clearings of *Betula*

papyrifera Marshall–*Picea glauca* (Moench) Voss–*Populus tremuloides* Michx. forest, and in boreal grasslands with *Achillea millefolium* L., *Anemone patens* L., *Artemisia frigida* Willd., *Carex duriuscula* C. A. Mey., *Comandra umbellata* (L.) Nutt., *Elymus lanceolatus* (Scribn. & J. G. Sm.) Gould, *Monarda fistulosa* L., *Poa cusickii* Vasey, and *Rosa acicularis* Lindl.

IUCN Red List category. Despite searches in grasslands along major portions of the British Columbia area of the Peace River and its major tributaries in 2008, no additional populations were found. Specimens of all *Erigeron* species that could be confused with *E. pacalis* (i.e., entire leaved and with non-woolly involucres) were examined at ALTA, CAN, PMAE, UBC, and V. No additional specimens of *E. pacalis* were found in these herbaria. The Peace Grasslands straddle the British Columbia–Alberta border; the Alberta portions of the grasslands have mostly been converted into farmland, and only about 0.5% of the original grassland area retains good-condition native vegetation (Baker, 2005). No approximations are available for the portion of the Peace Grasslands in British Columbia that remain in native vegetation, but a major share of the original grassland vegetation has been converted to agriculture, intense grazing, or other human uses, or has otherwise seen major degradation of vegetation condition. Major portions of the Peace Grasslands that have not been converted to agriculture have lost native plant cover as the invasive exotic species *Bromus inermis* Leyss. and *Melilotus* (L.) Mill. species continue to spread.

According to IUCN Red List (2001) criteria B2 (geographical range < 10 km^2) and due to ongoing severe threats from human use of the Peace River Valley, *Erigeron pacalis* falls under the Critically Endangered (CR) assessment.

Etymology. The species name comes from the Latin for "peace" or "peaceful," named after the Peace River Valley, where the type of the species was collected.

Discussion. Like members of *Erigeron* sect. *Erigeron* (Nesom, 2008), *E. pacalis* is short-stemmed, monocephalous and possessing of glandular hairs. However, the members of that section, unlike *E. pacalis*, have relatively poorly developed cauline leaves and ray corollas that are more distinctly coiling after anthesis. Additionally, in northwestern North America, the members of *Erigeron* sect. *Erigeron* are found only in arctic, alpine, and subalpine habitats. Hence, the affinities of *E. pacalis* are presumed to be instead with *Erigeron* sect. *Fruticosus* G. Don (Nesom, 2008). Like members of that section, *E. pacalis* has cauline leaves similar in shape and size to the basal leaves and ray corollas that remain straight or coil only slightly after anthesis. Like *E. pacalis*, several members of *Erigeron* sect. *Fruticosus* grow at lower elevations.

Several characteristics of *Erigeron pacalis* suggest that it is likely related to *E. glabellus* (*Erigeron* sect. *Fruticosus*), including its grassland habitat, fibrous roots, narrowly oblanceolate leaf shape, well-developed cauline leaves (i.e., cauline leaves similar in shape and size to the basal leaves), and in the indument of hirsute to hirsuto-villous hairs, similar to those of *E. glabellus* var. *pubescens* Hook. (although, in addition, there are shorter glandular hairs on *E. pacalis*). *Erigeron pacalis* differs from *E. glabellus* in its shorter stature (5–7 cm vs. 7–40 cm), in having heads consistently only one per stem (vs. one to 15 heads per stem), glandular hairs on distal parts, coriaceous (vs. softly herbaceous) leaves, and shorter ray and disc florets (5–6 mm vs. 8–15 mm).

Compared with *Erigeron pacalis*, most white-rayed individuals of *E. glabellus*, as that species is defined in the *Flora of North America* (Nesom, 2006), are much taller plants, 30–50(–70) cm, with larger heads (involucres 10–20 mm wide vs. 12–13.5 mm in *E. pacalis*), and with basal leaves acuminate and usually with prominent white midribs (apices rounded or blunt and midribs not so noticeable and white in *E. pacalis*). These white-rayed plants are common in the Peace River Grasslands and in the Canadian Prairies (east to Manitoba), and have been referred as *E. asper* Nutt. in earlier Canadian literature.

Cronquist (1947) synonymized *Erigeron asper* under *E. glabellus*, but the distinctions of that species from *E. glabellus* appear to be more clearly defined than Cronquist might have been aware of. *Erigeron asper* blooms mostly earlier (May to June) than the June to August flowering periods of *E. pacalis* and pink-flowered forms of *E. glabellus*, as evidenced by the collection dates reported on herbarium specimen labels, my own field observations in British Columbia, Alberta, and Saskatchewan, and the phenology observations of Scoggan (1979). Occasional white-rayed individuals are sometimes mixed in populations of pink-rayed *E. glabellus* s. str. (i.e., minus *E. asper*), but I know of no populations having only white rays, and those occasional white-rayed plants lack the other distinctions of *E. asper*.

Erigeron glabellus is highly diverse in morphological forms, even after *E. asper* is segregated. The pubescence types that define the two widely recognized varieties *glabellus* and *pubescens* are only one of several characters that potentially could define discrete morphotypes in the species. Much of the diversity of form, however, appears to be due to availability of light and soil nitrogen. Plants in shaded sites and on humus-rich soil are usually tall, lax plants with longer caudex branches, and those in full sun and nitrogen-poor soil are often diminutive, relatively erect, and more caespitose. The possibility was considered that the characteristic small size, monocephalous stems, and leathery leaves of *E. pacalis* represent drought-stress-induced plasticity, but I observed numerous *E. glabellus* populations in equally dry, sunny conditions in the Peace Grasslands that maintained the characteristics of *E. glabellus* in contrast to those of *E. pacalis* (i.e., taller stature, softly herbaceous leaves, larger flower heads that are often not solitary on the stems, longer rays, and lack of glandular hairs in *E. glabellus*). Additionally, some populations of *E. glabellus* observed in the Peace Grasslands on dry, warm south-facing slopes on well-drained soil were as tall, broad leaved and large headed as those growing in cool sites on rich soil in partial shade at forest margins or on river cut-banks.

Key to *Erigeron* Species of the Peace River Lowlands

1a. Plants short-lived (annual, biennial, or short-lived perennial), lacking a well-developed root crown or rhizomes; ray florets either inconspicuous and barely longer than the disc florets or longer but less than 1 mm wide 2
1b. Plants perennial, generally long-lived, with a well-developed root crown or stout rhizomes; ray florets usually showy, usually much longer than the disc florets, more than 1 mm wide 5
2a. Ray florets short and inconspicuous, if longer than the phyllaries, then erect or shortly spreading; involucre hemispheric to boxy; phyllaries with an abrupt bend, giving the involucre a shouldered appearance 3
2b. Ray florets long and conspicuous, much longer than the phyllaries; involucre turbinate or broadly hemispheric; phyllaries more or less straight or gradually curved 4
3a. Plants of saline or strongly alkaline wetlands; inflorescence usually much longer than wide; rayless unisexual female florets absent between the ray and bisexual disc florets ..... *E. lonchophyllus* Hook.
3b. Plants of woodlands, clearings, trail sides, or wetlands that are not strongly saline or alkaline; inflorescence moderately longer than wide; rayless unisexual female florets present between the ray and bisexual disc florets ... *E. acris* L. var. *kamtschaticus* (DC.) Herder [the similar *E. elatus* (Hook.) Greene also to be sought].
4a. Rays white, 2–6 mm long; plants with a slender, delicate appearance; basal and stem leaves 3–25 mm wide ..... *E. strigosus* Muhl. ex Willd.
4b. Rays purple or lavender (rarely white), 5–10 mm long; plants stout; basal and stem leaves 15–120 mm wide ..... *E. philadelphicus* L.
5a. Plants tall (mostly > 3 dm) and leafy; with no or only inconspicuous basal leaves; stems with large, conspicuous, lanceolate cauline leaves that scarcely reduce in size up the stem ..... *E. speciosus* (Lindl.) DC.
5b. Plants short (< 2 dm); stems with few cauline leaves, or with numerous and conspicuous cauline leaves, but then also with a distinct basal rosette 6
6a. Leaves deeply divided into threadlike segments ..... *E. compositus* Pursh
6b. Leaves entire 7
7a. Stems generally with two or more branches; harsh, spreading hairs on stems and leaves; basal leaves not forming distinct rosettes ..... *E. pumilus* Nutt.
7b. Stems not branched, or with one or occasionally two branches (not including peduncles leading to single flower heads); appressed or spreading hairs on stems, if spreading, then basal leaves forming distinct rosettes 8
8a. Stems with numerous (mostly > 10) appressed leaves; stems and leaves grayish with dense, appressed hairs; plants usually producing three or more stems per basal leaf cluster; stems usually arching outward from the base ..... *E. caespitosus* Nutt.
8b. Stems with few (mostly < 10), spreading leaves; stems and leaves green, with sparse to dense, spreading hairs; plants usually producing only one stem per basal leaf cluster; stems erect from the base 9
9a. Above-ground stems unbranched; ray florets white; minute glands present on phyllaries, distal cauline leaves and distal portions of stems ..... *E. pacalis*
9b. Above-ground stems often branched; ray florets white, pink or lavender; glands absent 10
10a. Ray florets white; leaf tip acuminate; midrib of basal leaves usually white and conspicuous; flowering May to June ..... *E. asper*
10b. Ray florets pink or lavender (or a few individuals albino); leaf tip acute, blunt, or rounded; midrib of basal leaves usually green and not conspicuous; flowering June to August ..... *E. glabellus* var. *pubescens*

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Two New Species of *Tropaeolum* (Tropaeolaceae) from South America

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Abstract. Two new South American species of *Tropaeolum* L. (Tropaeolaceae), *T. slanisii* Bulacio from Salta, Argentina, and *T. kieslingii* Bulacio from Tarija, Bolivia, found during a revision of the genus for the Flora of Argentina, are described, illustrated, and compared with related species. Both new species belong to *Tropaeolum* sect. *Tropaeolum*, which is characterized by the strongly heteromorphic petals, usually ciliate on the margins, and the entire or more or less deeply incised leaf blades.

Resumen. Se describen, ilustran y comparan dos nuevas especies de *Tropaeolum* L. (Tropaeolaceae), *T. slanisii* Bulacio de Salta, Argentina y *T. kieslingii* Bulacio de Tarija, Bolivia, descubiertas durante la revisión del género para la Flora Argentina. Ambas especies pertenecen a *Tropaeolum* secc. *Tropaeolum*, la cual se caracteriza por los pétalos marcadamente diferentes, ciliados en el margen y las láminas de las hojas enteras o más o menos divididas.

Key words: Argentina, Bolivia, IUCN Red List, South America, Tropaeolaceae, *Tropaeolum*.

The Tropaeolaceae are widely distributed in the temperate and subtropical lowlands of South America from Mexico to Patagonia, but their highest diversity can be found in the intertropical Andes (Sparre & Andersson, 1991). *Tropaeolum* L. has been treated with ca. 110 species, 78 of which are principally tropical taxa and 29 of which are primarily temperate (Berry, 1992; Andersson & Andersson, 2000; Watson & Flores, 2010). Recent molecular phylogenies support *Tropaeolum* as a single genus of two sections, sections *Tropaeolum* L. and *Chilensia* Sparre, and smaller segregate genera such as *Magallana* Cav. and *Trophaeastrum* Sparre have been submerged in its synonymy (Andersson & Andersson, 2000). Fourteen species of *Tropaeolum* were previously listed for Argentina (Zuloaga et al., 2008), and the description of one of the new species from Salta brings the total to 15. Most *Tropaeolum* species are fleshy vines with twining petioles and are easily distinguished by having peltate leaves and flowers with a calycine spur, five clawed petals, and eight stamens. The fruit is usually a 3-lobed schizocarp, and each carpel has a single seed.

During the study of the Tropaeolaceae for the Flora of Argentina, with plant material reviewed from South and North American herbaria (BAB, CORD, CTES, LIL, LP, MERL, SI, US), several specimens of *Tropaeolum* could not be identified to species. It should be mentioned that many trips to the countries were made to the localities where the distinctive material was collected and to similar adjacent areas in Argentina and Bolivia, but additional plants were not found. Further examination indicates that the specimens do represent new taxa, and they are described below as new species. By their bioform, *T. slanisii* Bulacio and *T. kieslingii* Bulacio both belong to *Tropaeolum* sect. *Tropaeolum*. This section is characterized by the petals being strongly heteromorphic, usually ciliate on the margins, often serrate, but not emarginated. The leaf blades are either entire or more or less deeply incised, although the central lobe is incised to a depth less than four fifths of the blade (Andersson & Andersson, 2000).

1. Tropaeolum kieslingii Bulacio, sp. nov. TYPE: Bolivia. Tarija: De Tarija a Narváez, 2000–2500 m, 19 Mar. 1982, *R. Kiesling, O. Ahumada, A. G. López & A. D. Rotman 3741* (holotype, SI). Figure 1.

Haec species *Tropaeolo meyeri* Sparre similis, sed ab eo petalis omnibus integris superioribus biauriculatis 7–10 × 3–5 mm, inferioribus acutis breviter mucronatis atque fructu globoso pubescente distinguitur.

Annual climbing herb; stems puberulous, with yellowish white indumentum. Leaves glabrous, marginally peltate, petioles 2–5 cm; blade light green, suborbicular, 1.8–3 × 2.5–4 cm, 3- to 5-lobed, lobes acute, entire or sometimes the upper ones 3-lobate in the middle, mucronate, somewhat cordate or truncate at the base, peltate. Flowers solitary or in pseudoracemes, pedicels ca. 2 cm. Calyx glabrescent, yellow, bilabiate, lower lobes larger than the upper ones; calyx spur 10–15 mm, funnelform, yellow with purple veins, straight or slightly recurved at the apex;

Figure 1. *Tropaeolum kieslingii* Bulacio. —A. Flower. —B. Fertile habit. —C. Upper and lower petals. —D. Stamen. —E. Pistil. —F. Fruit. Drawn from the type *R. Kiesling et al. 3741* (SI).

corolla yellow, both lower and upper petals being entire, lower petals lanceolate, acute, briefly mucronate, cuneate, upper petals 7–10 × 3–5 mm, with elliptic, unguiculate, biauriculate lobes. Fruit a pubescent schizocarp, with mixed indumentum, long trichomes moderately dense, yellowish white, short glandular trichomes, red-brown, 3 mericarps, 6–10 mm, globose, dark colored at maturity.

Habitat and distribution. *Tropaeolum kieslingii* is known only from the type collection from Tarija, Bolivia. It was collected from montane rainforests at ca. 2000–2500 m.

IUCN Red List category. *Tropaeolum kieslingii* is known only from the type specimen, so there is not enough information about its geographic distribution or population status. Therefore, it is not possible to assess its risk of extinction, and it must be included in the category DD or Data Deficient, according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Tropaeolum kieslingii* was collected both in flower and in fruit in March.

Etymology. The specific epithet honors Roberto Kiesling (1941–), a distinguished specialist of Cactaceae from Argentina who collected the type material of the new species.

Discussion. *Tropaeolum kieslingii* is distinguished by both lower and upper petals having entire margins. The upper petals are elliptic, obtuse, and biauriculate; the lower petals are acute and briefly mucronate, with a cuneate blade. *Tropaeolum kieslingii* appears to be closely related morphologically to *T. meyeri* Sparre, collected in the Argentine rainforest. The two species can be distinguished by the characters in the following key couplet.

1a. The 3 upper and lower petals with entire lobules; upper petals biauriculate, 7–10 × 3–5 mm; lower petals acute, briefly mucronate; fruit a globose schizocarp, pubescent. ..... *T. kieslingii*
1b. The 3 upper and lower petals with divided lobules; upper petals not auriculate, 5–7 × 2–4 mm; lower petals flabellate, ending in long cilia; fruit a conical schizocarp, glabrescent. ..... *T. meyeri*

2. Tropaeolum slanisii Bulacio, sp. nov. TYPE: Argentina. Salta: Dpto. Iruya, San Isidro, márgenes del río Las Cuevas, 2880 m, 26 Apr. 2001, *E. Bulacio & A. Slanis 817* (holotype, LIL). Figure 2.

Haec species *Tropaeolo seemannii* Buchenau similis, sed ab eo petalis superioribus 6.5–11 mm longis 3- ad 5-lobis mucronatis reflexis, inferioribus multilobis 14–17 mm longis atque calycis calcari 11–16 mm longo leviter recurvo ad apicem flavo venatione viridi distinguitur.

Annual climbing herb; stems glabrous to 3 m. Leaves marginally peltate, petioles 1.4–8.5 cm; blade light green, suborbicular, 1.2–5 × 1.4–6 cm, 3- to 5-lobed, lobes entire, emarginate, acute to sub-obtuse, briefly mucronate. Flowers solitary or in pseudo-racemes, pedicels to 3 cm. Calyx glabrescent, bilabiate, greenish yellow, lower lobes notably larger than the upper ones; calyx spur 11–16 mm, funnel-shaped, with the tip yellow and green venation, slightly recurved; petals yellow, the upper ones reflexed, 6.5–11 × 3–10 mm, with 3 to 5 lobes, acute, mucronate, with a brief claw, the lower petals flabellate, 14–17 × 10–13 mm, multi-lobed, lobes acute, ciliate, multi-lobed. Fruit a glabrous schizocarp of 3 large mericarps, 8 mm, darkened at maturity.

Habitat and distribution. *Tropaeolum slanisii* can be found in San Isidro (Salta, Argentina) in hillsides and plains of riverbanks on the margin of a mixed forest at ca. 2800 m.

IUCN Red List category. *Tropaeolum slanisii* is known only from three specimens, so there is insufficient information about either its geographic distribution or population status. Therefore, it is not possible to assess its conservation status, and it must be included in the category DD or Data Deficient, according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Tropaeolum slanisii* was collected both in flower and in fruit in April. It was noted with the common name of Guata-guata (Bulacio, pers. comm.).

Etymology. The specific epithet of the new species honors Alberto Slanis (1961–), a taxonomist, colleague, and friend, from the Fundación Miguel Lillo, who first collected *Tropaeolum slanisii* in 2001.

Discussion. *Tropaeolum slanisii* is closely related morphologically to *T. seemannii* Buchenau. The two species can be distinguished by the following key couplet.

1a. The 3 upper petals 3- to 5-lobed, 6.5–11 mm, mucronate, reflexed; lower petals multilobulate, 14–17 mm; tip of calyx spur yellow with green venation, 11–16 mm, slightly recurved; Argentina. ..... *T. slanisii*
1b. The 3 upper petals 3-lobed, 10–11 mm, lobules obtuse, but not mucronate; lower petals 3-lobed, the middle lobe further 3-lobulate, and the lateral lobes multilobulate; tip of calyx spur dark brown or purplish brown, 15–18 mm, straight; Peru and Bolivia. ..... *T. seemannii*

Paratypes. ARGENTINA. **Salta:** Dpto. Iruya. San Isidro, 6 Apr. 2000, *A. Slanis & J. Tolaba s.n.* (LIL); Camino a Campo Chiquero, en una pirca próxima a una plantación de maíz paralela al río Trihuasi, 26 Apr. 2001, *E. Bulacio & A. Slanis 818* (LIL).

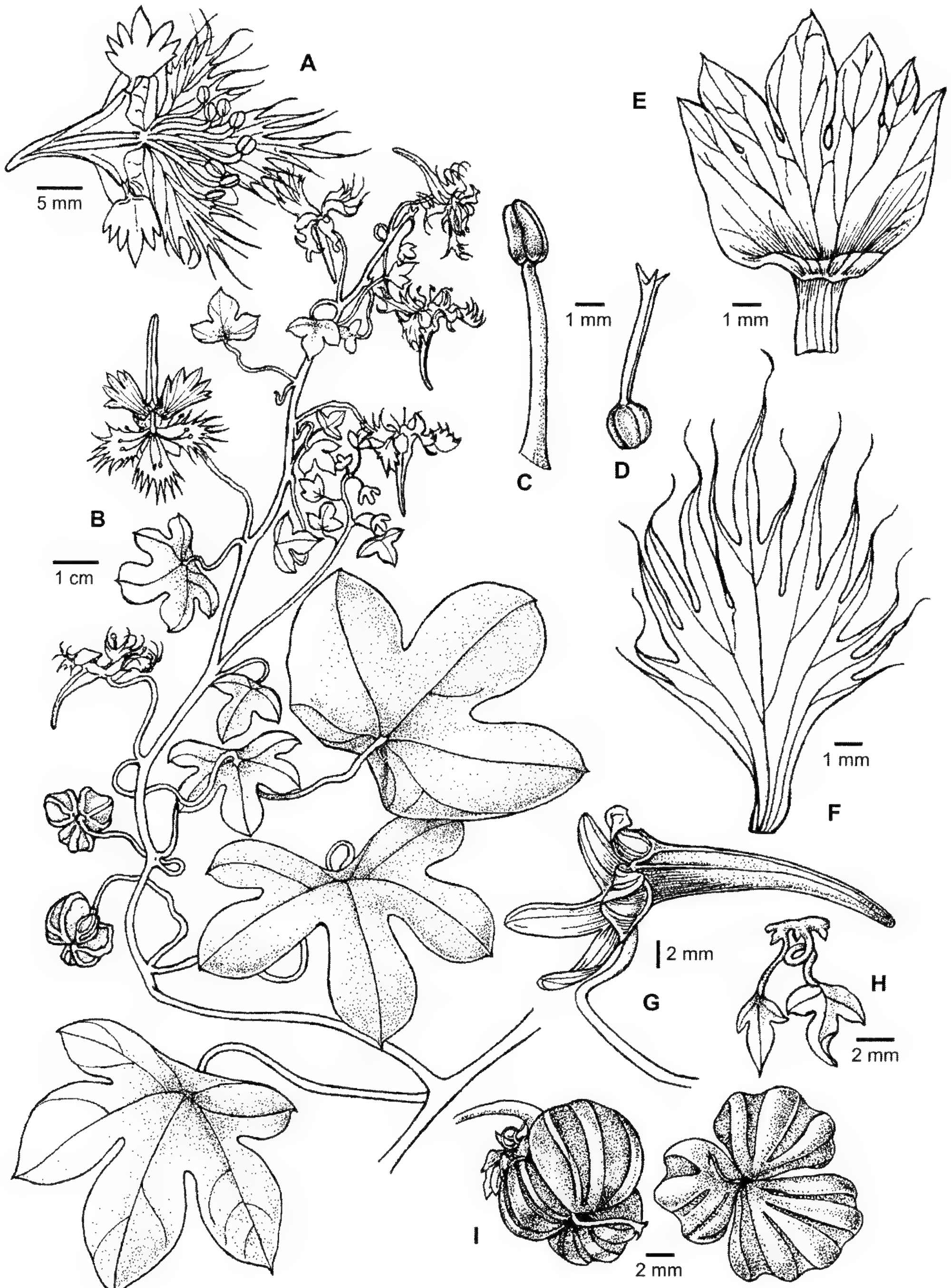

Figure 2. *Tropaeolum slanisii* Bulacio. —A. Dissected flower. —B. Fertile habit. —C. Stamen. —D. Pistil. —E. Upper petal. —F. Lower petal. —G. Calyx. —H. Peltate leaves. —I. Fruit. Drawn from the type *E. Bulacio & A. Slanis 817* (LIL).

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New Circumscription of the Endemic Brazilian Genus *Actinocephalus* (Eriocaulaceae)

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Abstract. Based initially on the morphological similarity between species belonging to *Actinocephalus* (Körn.) Sano and *Paepalanthus* Mart. subsect. *Aphorocaulon* Ruhland (Eriocaulaceae), these taxa were studied to clarify their relationships. After intensive fieldwork and morphological analyses of specimens belonging to *Paepalanthus* subsect. *Aphorocaulon* and *Actinocephalus*, we conclude that *Paepalanthus* subsect. *Aphorocaulon* and *Actinocephalus* should not be classified as different taxa. This taxonomic opinion is confirmed by published phylogenetic morphological and molecular data. We propose herein to include species of *Paepalanthus* subsect. *Aphorocaulon* in *Actinocephalus*. Thus nomenclatural and taxonomic changes are proposed in *Actinocephalus* and *Paepalanthus* with the following 16 new combinations: *A. actinocephaloides* (Silveira) F. N. Costa [≡ *P. actinocephaloides* Silveira], *A. arenicola* (Silveira) F. N. Costa [≡ *P. arenicola* Silveira], *A. armeria* (Mart. ex Körn.) F. N. Costa [≡ *P. armeria* Mart. ex Körn.], *A. bahiensis* (Bong.) F. N. Costa [≡ *P. bahiensis* (Bong.) Kunth], *A. barbiger* (Silveira) F. N. Costa [≡ *P. barbiger* Silveira], *A. geniculatus* (Bong.) F. N. Costa [≡ *P. geniculatus* (Bong.) Kunth], *A. glareosus* (Bong.) F. N. Costa [≡ *P. glareosus* (Bong.) Kunth], *A. heteropus* (Silveira) F. N. Costa [≡ *P. heteropus* Silveira], *A. incanus* (Bong.) F. N. Costa [≡ *P. incanus* (Bong.) Körn.], *A. longifolius* (Körn.) F. N. Costa [≡ *P. longifolius* Körn.], *A. perbracchiatus* (Silveira) F. N. Costa [≡ *P. perbracchiatus* Silveira], *A. phaeocephalus* (Ruhland) F. N. Costa [≡ *P. phaeocephalus* Ruhland], *A. rhizomatosus* (Silveira) F. N. Costa [≡ *P. rhizomatosus* Silveira], *A. scytophyllus* (Ruhland) F. N. Costa [≡ *P. scytophyllus* Ruhland], *A. trichopeplus* (Silveira) F. N. Costa [≡ *P. trichopeplus* Silveira], and *A. velutinus* (Silveira) F. N. Costa [≡ *P. velutinus* Silveira]. In addition, nine new synonyms and lectotypifications for the six following names are presented: *Paepalanthus* subsect. *Aphorocaulon* Ruhland, *Paepalanthus* subsect. *Aphorocaulon* β *Incani* Ruhland [unranked], *Paepalanthus* subsect. *Aphorocaulon* β *Condensati* Ruhland [unranked], *P. incanus* (Bong.) Körn. var. α Körn., *P. praemorsus* Ruhland, and *A. scytophyllus* (Ruhland) F. N. Costa. As newly circumscribed, the genus *Actinocephalus* comprises 49 species restricted to Brazil, with the Espinhaço Range as the center of species diversity. Species of *Actinocephalus* can be distinguished principally by the presence of paraclades covered by bracts and rarely a single scape arranged in an umbelliform coflorescence at the apex.

Resumo. Baseado inicialmente na similaridade morfológica entre as espécies pertencentes à *Actinocephalus* (Körn.) Sano e *Paepalanthus* Mart. subsect. *Aphorocaulon* Ruhland, estes táxons foram estudados a fim de elucidar suas relações. Após intensivo trabalho de campo e estudo da morfologia das espécies pertencentes a *Paepalanthus* subsect. *Aphorocaulon* and *Actinocephalus*, concluímos que não é possível reconhecer *Paepalanthus* subsect. *Aphorocaulon* and *Actinocephalus* como dois táxons distintos. O posicionamento das espécies de *Paepalanthus* subsect. *Aphorocaulon* em *Actinocephalus* também foi confirmado em análises filogenéticas publicadas por outros pesquisadores, empregando dados morfológicos e moleculares. Portanto, propomos aqui a inclusão das espécies de *Paepalanthus* subsect. *Aphorocaulon* em *Actinocephalus*, assim como as mudanças nomenclaturais e taxonômicas em *Actinocephalus* e *Paepalanthus*, com dezesseis novas combinações: *A. actinocephaloides* (Silveira) F. N. Costa [≡ *P. actinocephaloides* Silveira], *A. arenicola* (Silveira) F. N. Costa [≡ *P. arenicola* Silveira], *A. armeria* (Mart. ex Körn.) F. N. Costa [≡ *P. armeria* Mart. ex Körn.], *A. bahiensis* (Bong.) F. N. Costa [≡ *P. bahiensis* (Bong.) Kunth], *A. barbiger* (Silveira) F. N. Costa [≡ *P. barbiger* Silveira], *A. geniculatus* (Bong.) F. N. Costa [≡ *P. geniculatus* (Bong.) Kunth], *A.*

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glareosus (Bong.) F. N. Costa [≡ *P. glareosus* (Bong.) Kunth], *A. heteropus* (Silveira) F. N. Costa [≡ *P. heteropus* Silveira], *A. incanus* (Bong.) F. N. Costa [≡ *P. incanus* (Bong.) Körn.], *A. longifolius* (Körn.) F. N. Costa [≡ *P. longifolius* Körn.], *A. perbracchiatus* (Silveira) F. N. Costa [≡ *P. perbracchiatus* Silveira], *A. phaeocephalus* (Ruhland) F. N. Costa [≡ *P. phaeocephalus* Ruhland], *A. rhizomatosus* (Silveira) F. N. Costa [≡ *P. rhizomatosus* Silveira], *A. scytophyllus* (Ruhland) F. N. Costa [≡ *P. scytophyllus* Ruhland], *A. trichopeplus* (Silveira) F. N. Costa [≡ *P. trichopeplus* Silveira], and *A. velutinus* (Silveira) F. N. Costa [≡ *P. velutinus* Silveira]. Também são propostas nove novas sinonímias e lectotipificações para os seis nomes: *Paepalanthus* subsect. *Aphorocaulon* Ruhland, *Paepalanthus* subsect. *Aphorocaulon* β *Incani* Ruhland [unranked], *Paepalanthus* subsect. *Aphorocaulon* β *Condensati* Ruhland [unranked], *P. incanus* (Bong.) Körn. var. α Körn., *P. praemorsus* Ruhland e *A. scytophyllus* (Ruhland) F. N. Costa. Considerando esta nova circunscrição, o gênero *Actinocephalus* abrange 49 espécies restritas ao Brasil, com centro de diversidade localizado na Cadeia do Espinhaço. Os representantes deste gênero podem ser distinguidos principalmente pela presença de paracládios cobertos por brácteas e portando, no ápice, um único escapo ou então numerosos escapos em um arranjo umbeliforme.

Key words: *Actinocephalus*, Brazil, Eriocaulaceae, *Paepalanthus*.

Sano (2004) elevated a section within *Paepalanthus* Mart., section *Actinocephalus* (Körn.) Ruhland, to generic rank as *Actinocephalus* (Körn.) Sano. The genus is distinguished from other genera of Eriocaulaceae principally by coflorescences with an umbellate arrangement of capitula. The subsequent taxonomic revision of *Paepalanthus* subsect. *Aphorocaulon* Ruhland (Costa, 2005) indicated that many of the species in this subsection also have an umbelliform arrangement of the capitula rather than a fasciculate form, although these coflorescences were previously designated as "inflorescences in fascicle" by Ruhland (1903: 167). Species of *Paepalanthus* subsect. *Aphorocaulon* indeed share other characters with *Actinocephalus*, which include paraclades that are covered by foliage bracts, trimerous flowers, simple stigmas, and staminodes that are evident in the pistillate flowers. Taxonomic revision by Costa (2005) clearly supported the inclusion of species in *Paepalanthus* subsect. *Aphorocaulon* within the segregate genus *Actinocephalus* sensu Sano (2004). Recent phylogenetic studies of Eriocaulaceae based on morphological and molecular data (Giulietti et al., 2000; Unwin, 2004; Andrade et al., 2010) indicate that *Actinocephalus* would be monophyletic if *Paepalanthus* subsect. *Aphorocaulon* were included. Therefore, based mainly on morphological studies, but also supported by molecular data, we transfer the species of this subsection to *Actinocephalus*. Also reported herein are associated and novel nomenclatural actions that result from the new circumscription of the genus *Actinocephalus*.

I. Actinocephalus (Körn.) Sano, Taxon 53(1): 99. 2004. *Paepalanthus* Mart. subg. *Actinocephalus* Körn., in Martius and Eichler, Fl. Bras. 3(1): 321. 1863. *Paepalanthus* sect. *Actinocephalus* (Körn) Ruhland in Engler, Pflanzenr. IV, 30 (Heft 13): 189. 1903. TYPE: *Actinocephalus polyanthus* (Bong.) Sano (lectotype, designated by Sano [2004: 99]).

Paepalanthus sect. *Actinocephalus* β *Ramosi* Ruhland [unranked], in Engler, Pflanzenr. IV, 30 (Heft 13): 189. 1903. TYPE: *Actinocephalus ramosus* (Wikstr.) Sano.

Paepalanthus sect. *Actinocephalus* β *Perbreves* Ruhland [unranked], in Engler, Pflanzenr. IV, 30 (Heft 13): 189. 1903. TYPE: *Actinocephalus rigidus* (Bong.) Sano (lectotype, designated by Sano [2004: 99]).

Paepalanthus subsect. *Aphorocaulon* Ruhland, in Engler, Pflanzenr. IV, 30 (Heft 13): 167. 1903. TYPE: *Actinocephalus geniculatus* (Bong.) F. N. Costa (lectotype, designated here).

Paepalanthus subsect. *Aphorocaulon* β *Incani* Ruhland [unranked], in Engler, Pflanzenr. IV, 30 (Heft 13): 168. 1903. TYPE: *Actinocephalus incanus* (Bong.) F. N. Costa (lectotype, designated here).

Paepalanthus subsect. *Aphorocaulon* β *Condensati* Ruhland [unranked], in Engler, Pflanzenr. IV, 30 (Heft 13): 168. 1903. TYPE: *Actinocephalus glareosus* (Bong.) F. N. Costa (lectotype, designated here).

Plants perennial or monocarpic perennial; rhizomes present or not; stems short or elongate, densely lanate, internodes short with leaves in basal rosettes; rosettes persistent or deciduous. Leaves lanceolate or linear, adpressed to reflexed, light to dark green or grayish green, glabrous to densely pilose, margins flat to involute, ciliate to smooth, apices pointed to mucronulate, glabrous to densely barbellate. Elongated fertile axis present or absent, ramification present or not, arising from the apex of the basal rosette; axis of the synflorescence present or not, arising always from the apex of the rosette; paraclades axillary to the rosette leaves or arising from a central axis or lateral axis of the synflorescence, densely pilose in the region of insertion in the bracts; bracts occurring spirally along axis and paraclades, deciduous or persistent, foliaceous, lanceolate, their coloration, pilosity, margins, and apices similar to the rosette leaves; spathes membranous, glabrous to pilose, broad to narrow, apices oblique to truncate,

ciliate or glabrous; scapes persistent or deciduous, arising always from the apex of the paraclades, ranging from 1 to 800 per paraclade, arranged in an umbel, glabrous to densely pilose, trichomes simple or T-shaped; capitula persistent or deciduous, white, ochre, or sulfurous yellow in color; receptacles always pilose, trichomes equal to or longer than flowers; involucral bracts cream-colored to dark brown, in 2 to numerous series, oblong to broadly ovate, concave, both faces glabrous to pilose, margins glabrous to pilose, apices truncate to pointed, apiculate or not. Flowers diclinous, trimerous, 20 to 600 per capitulum, staminate and pistillate flowers positioned variably on the capitulum, trichomes of the perianth smooth or tuberculate, trichomes with internal ornamentation present or absent; floral bracts always present, obovate to linear, concave to navicular. Staminate flowers pedicellate, the pedicel glabrous to pilose, sepals briefly connate at the base, light brown to black, ciliate; sepal apices always pilose; corollas infundibular, urceolate or tubular, smooth, base of the corolla conspicuously carnose, lobes 3 to 6, hyaline, entire or bifid, involute only after anthesis; stamens 3, exerted, filaments cylindrical, adnate to the corolla tube only in the basal portion; anthers dorsifixed, bithecate; pistillodes 3, clavate to cylindric, densely covered with papillose trichomes. Pistillate flowers sessile or pedicellate; sepals free, light brown to black, ciliate, sepal apices always pilose; petals free, hyaline, apices pilose or glabrous; staminodes squamiform in the region of the gynoecial septa; gynoecium 3-locular, styles and appendages always free at the same height on the column of the gynoecium; appendages pyriform or clavate, covered by short or long papillose trichomes; styles filiform, with the same length or longer than the appendages; stigmas always simple. Fruit a loculicidal capsule; seeds 1–2 mm, red-brown to dark brown, testa densely reticulate.

List of included taxa. (Forty-nine species; five varieties; asterisks indicate names transferred herein.) **Actinocephalus actinocephaloides* (Silveira) F. N. Costa, *A. aggregatus* F. N. Costa, **A. arenicola* (Silveira) F. N. Costa, **A. armeria* (Mart. ex Körn.) F. N. Costa, **A. bahiensis* (Bong.) F. N. Costa, **A. barbiger* (Silveira) F. N. Costa, *A. bongardii* (A. St.-Hil.) Sano, *A. brachypus* (Bong.) Sano, *A. cabralensis* (Silveira) Sano, *A. callophyllus* (Silveira) Sano, *A. ciliatus* (Bong.) Sano, *A. cipoensis* (Silveira) Sano, *A. claussenianus* (Körn.) Sano, *A. compactus* (Gardner) Sano, *A. coutoensis* (Moldenke) Sano, *A. deflexus* F. N. Costa, *A. delicatus* Sano, *A. denudatus* (Körn.) Sano, *A. diffusus* (Silveira) Sano, *A. divaricatus* (Bong.) Sano, *A. falcifolius* (Körn.) Sano, *A. fimbriatus* (Silveira) Sano, **A. geniculatus* (Bong.) F. N. Costa, *A. giuliettiae* Sano, *A. glabrescens* (Silveira) Sano, **A. glareosus* (Bong.) F. N. Costa, *A. graminifolius* F. N. Costa, *A. herzogii* (Moldenke) Sano, *A. herzogii* var. *herzogii*, *A. herzogii* var. *humilis* (Sano) Sano, **A. heteropus* (Silveira) F. N. Costa, *A. heterotrichus* (Silveira) Sano, **A. incanus* (Bong.) F. N. Costa, *A. ithyphyllus* (Mart.) Sano, *A. koernickeanus* Trovó & F. N. Costa, **A. longifolius* (Körn.) F. N. Costa, *A. nodifer* (Silveira) Sano, *A. ochrocephalus* (Körn.) Sano, *A. pachyphyllus* (Körn.) F. N. Costa, Trovó & Echtern., **A. perbracchiatus* (Silveira) F. N. Costa, **A. phaeocephalus* (Ruhland) F. N. Costa, *A. polyanthus* (Bong.) Sano, *A. polyanthus* var. *bifrons* (Silveira) Sano, *A. polyanthus* var. *plumipes* (Silveira) Sano, *A. polyanthus* var. *polyanthus*, *A. ramosus* (Wikstr.) Sano, **A. rhizomatosus* (Silveira) F. N. Costa, *A. rigidus* (Bong.) Sano, *A. robustus* (Silveira) Sano, **A. scytophyllus* (Ruhland) F. N. Costa, *A. stereophyllus* (Ruhland) Sano, **A. trichopeplus* (Silveira) F. N. Costa, **A. velutinus* (Silveira) F. N. Costa, and *A. verae* Sano & Trovó.

Discussion. *Actinocephalus* species can be recognized principally by the presence of paraclades that are obscured by foliage bracts and numerous scapes for each paraclade in an umbellate coflorescence, with rarely a single scape. Flowers are trimerous, and stigmas are simple. With the new circumscription herein and seven species described recently (Costa, 2006; Trovó & Costa, 2009; Trovó & Sano, 2010; Echternacht et al., 2011), as well as one reestablishment and new combination (Trovó et al., 2012), the genus *Actinocephalus* now comprises 49 species restricted in geographic distribution to Brazil, occurring mainly in the Espinhaço Range of Minas Gerais and Bahia.

Ruhland (1903) proposed *Paepalanthus* subsect. *Aphorocaulon* and divided this subsection into two unranked subgroups, *Paepalanthus* [unranked] *Incani* and *P.* [unranked] *Condensati*. However, Ruhland (1903) did not designate the type species, and thus it is necessary to designate the lectotypes. These species here designated are the most commonly recognized and widespread of these taxa.

1. **Actinocephalus actinocephaloides** (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus actinocephaloides* Silveira, Floral. Mont. 1: 135, tab. 84. 1928. TYPE: Brazil. Minas Gerais: Diamantina, "in campis prope Diamantina," Apr. 1918, *A. Silveira 687* (holotype, R).

2. **Actinocephalus arenicola** (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus arenicola*

Silveira, Floral. Mont. 1: 144, tab. 90. 1928. TYPE: Brazil. Minas Gerais: Santana do Riacho, "in arenosis camporum prope Bandeirinhas, Serra do Cipó," Apr. 1909, *A. Silveira 552* (holotype, R).

Paepalanthus gibbosus Silveira, Floral. Mont. 1: 142, tab. 89. 1928, syn. nov. TYPE: Brazil. Minas Gerais: Gouveia, "in campis, prope Contagem in Serra do Riacho do Vento, inter Diamantina, et Curvello," Apr. 1908, *A. Silveira 505* (holotype, R).

Discussion. Silveira (1928) assumed that *Paepalanthus arenicola* and *P. gibbosus* shared similar roots, stems, leaves, and paraclades. He distinguished both species by differences related to the length of scapes and additional characters such as the capitula shape and the color of trichomes on the receptacle. Nevertheless, the specimens identified under either species name do not exhibit convincing characteristics to support their distinction as separate taxa. Both species were concomitantly described by Silveira (1928), and the epithet *arenicola* preferred here refers to the sandy soil in which the species is found. This decision is supported by Article 11.5 of the Code (McNeill et al., 2006).

3. Actinocephalus armeria (Mart. ex Körn.) F. N. Costa, comb. nov. Basionym: *Paepalanthus armeria* Mart. ex Körn., in Martius & Eichler, Fl. Bras. 3(1): 377. 1863. *Dupatya armeria* (Mart. ex Körn.) Kuntze, Revis. Gen. Pl. 2: 745. 1891. TYPE: Brazil. Goiás: "Crescit in prov. Goyazensis Chapada de S. Marcos," s.d., *J. B. E. Pohl s.n.* (holotype, M).

Discussion. Koernicke (1863: 377) validly published the name *Paepalanthus armeria* in *Flora Brasiliensis*, attributing the first use of the name to Martius in sched., but this was never published. Koernicke did note a collection of this species (*Pohl s.n.*) in the 1863 protologue, and there is a collection of this species deposited at M. We studied this collection here and identify it as the holotype of *P. armeria*.

4. Actinocephalus bahiensis (Bong.) F. N. Costa, comb. nov. Basionym: *Eriocaulon bahiense* Bong., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1: 622. 1831. *Paepalanthus bahiensis* (Bong.) Kunth, Enum. Pl. 3: 517. 1841. *Dupatya bahiensis* (Bong.) Kuntze, Revis. Gen. Pl. 2: 745. 1891. TYPE: Brazil. Bahia: "Habitat prope Rio dos Contos, provinciae Bahiensis," Feb. 1821, *L. Riedel s.n.* (holotype, LE [barcode] 00001043 not seen, LE [barcode] 00001043 digital image).

Paepalanthus variabilis Silveira, Fl. Serr. Min. 49, tab. 17. 1908, syn. nov. TYPE: Brazil. Minas Gerais: "In campis, loccis siccis arenosisque, in Serra do Cipó," Apr. 1905, *A. Silveira 313* (holotype, R; isotype, B [barcode] 10 0247629).

Paepalanthus variabilis var. *glabrescens* Silveira, in Silveira, Floral. Mont. 1: 156, tabs. 97–98. 1928, syn. nov. TYPE: Brazil. Minas Gerais: "In campis arenosis in Serra do Cabral," Nov. 1918, *A. Silveira 645* (holotype, R).

Paepalanthus conicus Silveira, Floral. Mont. 1: 136, tab. 85. 1928, syn. nov. TYPE: Brazil. Minas Gerais: "In campis prope Milho Verde, in Serra do Espinhaço," June 1925, *A. Silveira 759* (holotype, R).

Paepalanthus polyandrus Silveira, Floral. Mont. 1: 140, tab. 88. 1928, syn. nov. TYPE: Brazil. Minas Gerais: "In campis arenosis in Serra do Cabral," Nov. 1918, *A. Silveira 646* (holotype, R).

Discussion. Although the type of *Actinocephalus bahiensis* was noted in the protologue (Bongard, 1831) as collected in Bahia, its current distribution appears to be restricted to Minas Gerais. Possibly the label of the sheet was changed, or the species had a wider geographic distribution in the past, but in fact it is not possible to confirm this distribution.

This species presents great morphological variability, and because of this, many new taxa were formerly described. However, these represent the extreme of this variability, mainly in relation to the size and indument, and new synonyms for two species and two varieties are herein proposed.

5. Actinocephalus barbiger (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus barbiger* Silveira, Fl. Serr. Min. 47, tab. 16. 1908. TYPE: Brazil. Minas Gerais: "in campis arenosis siccisque prope Morro do Breu, in Serra do Cipó," Apr. 1905, *A. Silveira 352* (holotype, R; isotypes, B [barcode] 10 0247853, OUPR).

6. Actinocephalus geniculatus (Bong.) F. N. Costa, comb. nov. Basionym: *Eriocaulon geniculatum* Bong., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1: 625. Fig. 31. 1831. *Paepalanthus geniculatus* (Bong.) Kunth, Enum. Pl. 3: 521. 1841. *Dupatya geniculata* (Bong.) Kuntze, Revis. Gen. Pl. 2: 745. 1891. TYPE: Brazil. Minas Gerais: "Habitat in glareosis subhumidis Serra da Lapa," Dec. 1824, *L. Riedel 1064* (holotype, LE [barcode] 00002826 digital image; isotypes, B [barcode] 10 0247780, G [barcode] 00098971, K [barcode] 000640028, P [barcode] 00670062).

Paepalanthus myriophyllus Silveira, Floral. Mont. 1: 147, tab. 92. 1928, syn. nov. TYPE: Brazil. Minas Gerais: "In campis inter Serro et Datas, in Serra do Geral," June 1925, *A. Silveira 760* (holotype, R).

Discussion. Silveira (1928) placed his new species *Paepalanthus myriophyllus* in *Paepalanthus* subsect. *Aphorocaulon*. However, the holotype of *P. myriophyllus* corresponds to *Actinocephalus geniculatus*, based on common features such as the linear leaves and short paraclades (0.8–3.5 cm) with few scapes (one to three).

7. **Actinocephalus glareosus** (Bong.) F. N. Costa, comb. nov. Basionym: *Eriocaulon glareosum* Bong., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1: 625, tab. 25. 1831. *Paepalanthus glareosus* (Bong.) Kunth, Enum. Pl. 3: 521. 1841. *Dupatya glareosa* (Bong.) Kuntze, Revis. Gen. Pl. 2: 745. 1891. TYPE: Brazil. Minas Gerais: "In glareosis loccis Serra da Lapa," Nov. 1824, *L. Riedel 1043* (holotype, LE [barcode] 00001170, isotypes, B [barcode] 10 0247778, G [barcode] 00099138, K [barcode] 000640029, P [barcode] 01762678).

8. **Actinocephalus heteropus** (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus heteropus* Silveira, Floral. Mont. 1: 139, tab. 87. 1928. TYPE: Brazil. Minas Gerais: "In campis arenosis prope Itambé do Serro," Apr. 1918, *A. Silveira 686* (holotype, R).

9. **Actinocephalus incanus** (Bong.) F. N. Costa, comb. nov. Basionym: *Eriocaulon incanum* Bong., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1: 623, tab. 61. 1831. *Paepalanthus incanus* (Bong.) Körn. var. β Körn., in Martius & Eichler, Fl. Bras. 3(1): 380. 1863. *Dupatya incana* (Bong.) Kuntze, Revis. Gen. Pl. 2: 746. 1891. TYPE: Brazil. Minas Gerais: "In arenosis prope Tejuco [Diamantina]," Dec. 1824, *L. Riedel s.n.* (holotype, LE [barcode] 00001080).

Paepalanthus incanus (Bong.) Körn. var. α Körn., in Martius & Eichler, Fl. Bras. 3(1): 380. 1863, syn. nov. TYPE: Brazil. "in Brasilia orientali; Princ. Neovid.; et in prov. Minarum [Minas Gerais] altis frigidiusculis districtus Serro Frio: M.," s.d., *Pohl s.n.* (lectotype, designated here, M).

Paepalanthus hemiglobosus Silveira, Floral. Mont. 1: 181, tab. 117. 1928, syn. nov. TYPE: Brazil. Minas Gerais: "In campis arenosis inter Serro et Datas," June 1925, *A. Silveira 783* (holotype, R).

Discussion. Koernicke (1863: 380) cited and described two varieties for *Paepalanthus incanus*, "var. α.: caule perbreve," with a very short stem, and "var. β: caule elongate," with a long stem. The second variety (β) corresponds to the type for *Eriocaulon incanus*, cited by Bongard (1831: 623) as "habitat in arenosis prope Tejuco." However, for *P. incanus* var. α, Koernicke referred to localities and not to any particular collection, noting variety α "in Brasilia orientali; Princ. Neovid.; et in prov. Minarum altis frigidiusculis districtus Serro Frio: M." Only the letter "M" was cited, perhaps in reference to the herbarium M or to a collection seen by Martius. Within the collections at the Munich herbarium, we identified one sheet of *P. incanus* collected by Pohl without number or date yet with comments in Koernicke's handwriting, which we interpret and designate as the lectotype for variety α. There are also numerous sheets of *Actinocephalus incanus* [≡ *P. incanus*] at Munich, but they are annotated with the unpublished name *P. frigidulus* used by Martius.

Later, Ruhland (1903) cited several sheets for the species *Paepalanthus incanus*, among them two specimens collected by Riedel, one being *L. Riedel s.n.* (holotype, LE [barcode] 00001080) from Tejuco, currently known as the Diamantina Municipality of Minas Gerais, and the other one being *L. Riedel s.n.* (herbarium of deposit not stated) from "bei Ilheos und Camamu" in Bahia. However, *Actinocephalus incanus* is restricted to Minas Gerais, and the material collected in "Ilheos und Camamu" in Bahia has not been found as deposited at any of the herbaria visited by the authors. Species of *Actinocephalus* and other related genera do occur in the mountains of Espinhaço Range and on sand dunes of the Atlantic littoral zone, but *P. incanus* does not occur there.

Paepalanthus hemiglobosus was described by Silveira in *Paepalanthus* subsect. *Actinocephaloides* Ruhland, but the type is morphologically identical to *Actinocephalus incanus*, sharing a tomentose spathe, cream-colored involucral bracts, and ramification characteristic of the plants.

10. **Actinocephalus longifolius** (Körn.) F. N. Costa, comb. nov. Basionym: *Paepalanthus longifolius* Körn., in Martius & Eichler, Fl. Bras. 3(1): 333. 1863. *Dupatya longifolia* (Körn.) Kuntze, Revis. Gen. Pl. 2: 746. 1891. TYPE: Brazil. Minas Gerais: "Crescit in Brasilia centrali," s.d., *L. Riedel s.n.* (holotype, LE).

Paepalanthus applanatus Ruhland, in Engler, Pflanzenr. IV, 30 (Heft 13): 169. 1903, syn. nov. TYPE: Brazil. Minas Gerais: "Serra do Cipó, dans le campo, prés Congonhas," 24 Apr. 1892, *A. F. M. Glaziou 19973* (holotype, B [barcode] 10 0157347, isotypes, MO-1664485, P).

Discussion. *Paepalanthus applanatus* was described by Ruhland (1903) in *Paepalanthus* subsect. *Aphorocaulon*, and the type belongs to *Actinocephalus*

longifolius, based on common features such as the presence of an elongated fertile axis and scapes with trichomes that are T-shaped.

11. Actinocephalus perbracchiatus (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus perbracchiatus* Silveira, Floral. Mont. 1: 137, tab. 86. 1928. TYPE: Brazil. Minas Gerais: "In campis arenosis inter Serro et Datas, in Serra do Espinhaço," June 1925, *A. Silveira 757* (holotype, R).

12. Actinocephalus phaeocephalus (Ruhland) F. N. Costa, comb. nov. Basionym: *Paepalanthus phaeocephalus* Ruhland, in Engler, Pflanzenr. IV, 30 (Heft 13): 169. 1903. TYPE: Brazil. Goiás: "Cabeceira do Rio Sant'Anna, dans le bois," 8 Jan. 1895, *A. F. M. Glaziou 22314* (holotype, R; isotypes, G [barcode] 00099079, K [barcode] 000640030, P [barcode] 00741971).

13. Actinocephalus rhizomatosus (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus rhizomatosus* Silveira, Floral. Mont. 1: 148, tab. 93. 1928. TYPE: Brazil. Minas Gerais: "In campis prope Baraunas, in Serra Geral," June 1925, *A. Silveira 761* (holotype, R).

14. Actinocephalus scytophyllus (Ruhland) F. N. Costa, comb. nov. Basionym: *Paepalanthus scytophyllus* Ruhland, in Engler, Pflanzenr. IV, 30 (Heft 13): 171. 1903. TYPE: Brazil. Minas Gerais: "Tombador prés Diamantina, dans le campo," 4 Apr. 1892, *A. F. M. Glaziou 19967* (lectotype, designated here, B [barcode] 10 0157349; isolectotypes, K, MO-1664562, P [barcode] 00741986).

Discussion. Ruhland (1903: 171) cited two collections from Minas Gerais when he described *Paepalanthus scytophyllus*. The first collection was *Glaziou n. 19971* from "Pinheiro, auf trockenen Campos"; the second, "*Derselbe [Glaziou] n. 19967*," was noted as being from "Tombador bei Diamantina, auf Campos." It is necessary to designate the lectotype between these two syntypes, with the collection *Glaziou n. 19967* chosen because it is more representative of the taxon than *Glaziou n. 19971*.

15. Actinocephalus trichopeplus (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus trichopeplus* Silveira, Fl. Serr. Min. 46. 1908. TYPE: Brazil. Minas Gerais: Serra do Cipó, Apr. 1905, *A. Silveira 353* (holotype, R; isotype, B [barcode] 10 0247641).

16. Actinocephalus velutinus (Silveira) F. N. Costa, comb. nov. Basionym: *Paepalanthus velutinus* Silveira, Floral. Mont. 1: 145, tab. 91. 1928. TYPE: Brazil. Minas Gerais: "In campis arenosis in Serra do Cabral," May 1910, *A. Silveira 577* (holotype, R).

Excluded Taxa from *Actinocephalus*

1. *Paepalanthus microphorus* Silveira, Floral. Mont. 1: 149, tab. 94. 1928. TYPE: Brazil. Minas Gerais: "In campis prope Milho Verde, in Serra Geral," June 1925, *A. Silveira 762* (holotype, R).

Discussion. *Paepalanthus microphorus* does not have paraclades, and the flowers are dimerous, in marked contrast to the trimerous flowers and paraclades in *Actinocephalus*. The species is best placed in *Paepalanthus* ser. *Dimeri* (Ruhland) Giul.

Paepalanthus macrocephalus (Bong.) Körn., *P. praemorsus* Ruhland, and *P. scholiophyllus* Ruhland were included by Ruhland (1903) in *Paepalanthus* subsect. *Aphorocaulon*, but these species are morphologically distinct from *Actinocephalus* mainly by the absence of paraclades and a bifid stigma (vs. simple stigma in *Actinocephalus*) in *P. praemorsus*. These three species are best placed in *Paepalanthus* ser. *Variabiles* Ruhland.

2. *Paepalanthus macrocephalus* (Bong.) Körn., in Martius & Eichler, Fl. Bras. 3(1): 379. 1863. Basionym: *Eriocaulon macrocephalum* Bong., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1: 630, tab. 33. 1831. *Dupatya macrocephala* (Bong.) Kuntze, Revis. Gen. Pl. 2: 746. 1891. TYPE: Brazil. Minas Gerais: "In pratis humidis Serra da Lapa," Nov. 1824, *L. Riedel 1036* (holotype, LE [barcode] 00001127, isotypes, B [barcode] 10 0243932, G [barcode] 00099097, K [barcode] 000640027, P).

3. *Paepalanthus praemorsus* Ruhland, in Engler, Pflanzenr. IV, 30 (Heft 13): 172. 1903. TYPE: Brazil. Minas Gerais: "Tombador, prés Diamantina," 8 Apr. 1892, *A. F. M. Glaziou 19960* (lectotype, designated here, B [barcode] 10 0157351; isolectotypes, K, P [barcode] 00741973, 75, 76 [3]).

Discussion. Ruhland (1903: 172) cited two collections from Minas Gerais when he described *Paepalanthus praemorsus*. The first collection was *Glaziou n. 19960* from "Tombador, bei Diamantina"; the second Glaziou collection, "*Derselbe [Glaziou] n. 19966*," was noted as being from "Serra dos Cristaes, bei Diamantina." It is necessary to designate the

lectotype between these two syntypes, and the collection *Glaziou n. 19960* is chosen because it is more representative of the taxon than *Glaziou n. 19966*.

4. *Paepalanthus scholiophyllus* Ruhland, in Engler, Pflanzenr. IV, 30 (Heft 13): 172. 1903. TYPE: Brazil. Goiás: "Capelinha de Santo Antonio dans le campo," 23 Oct. 1894, *A. F. M. Glaziou 22315* (holotype, B [barcode] 10 0157342; isotypes, G [barcode] 00099073, K [barcode] 00099073, P [barcode] 00741982).

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Esenbeckia cowanii (Rutaceae), Epitypification and Emendation

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Abstract. A complete description of *Esenbeckia cowanii* Kaastra (Rutaceae) is presented, including new details for floral morphology. The original type of this taxon included only fruiting material, thus we designate an epitype with flowers. In addition, we provide taxonomic emendation to *E. cowanii*, including its leaf morphology variation, details of the fruit and seed, and an update of its geographic distribution.

Key words: Brazil, *Esenbeckia*, Pilocarpinae, Rutaceae.

Esenbeckia Kunth (Rutaceae, Rutoideae, Galipeeae, Pilocarpinae) comprises 28 species that occur in the Neotropics. A monograph of the entire subtribe was presented by Kaastra (1982) for *Flora Neotropica*, and previous work (Pirani, 1999) contributed two new species to the genus.

Esenbeckia cowanii Kaastra was described in 1977 and known from only two collections from the same locality in French Guiana, from the type *Cowan 38833* and paratype *Cowan 38757* (K not seen, NY, P not seen). Kaastra (1977) described the novel taxon without knowing its flower morphology: both collections, including all duplicates, are non-flowering. Moreover, the chief diagnostic feature used by Kaastra (1977, 1982) to differentiate *E. cowanii* from *E. almawillia* Kaastra (the other species included in *Esenbeckia* Kunth subg. *Lateriflorens* Kaastra) was the winged petiole, which is clearly variable. However, the inflorescence typology was not fully described by Kaastra in the protologues (described there as a panicle or variation thereof), and this represents a major distinction between these species. Thus, according to Article 9 in the International Code of Botanical Nomenclature (McNeill et al., 2006), an epitype may be designated, which we do here. Additionally, we provide a taxonomic emendation to *E. cowanii*, including leaf morphology variation, floral morphology, fruit and seed detail, and an updated geographic distribution.

Esenbeckia cowanii Kaastra, Acta Bot. Neerl. 26: 481, t. 7, 1977. TYPE: French Guiana. Guyane, Montagne de Kaw, 250–270 m, 14 Dec. 1954 (fr.), *R. S. Cowan 38833* (holotype, US-00101521; isotypes, F0071245, NY 00051857). EPITYPE: Brazil. Mato Grosso: Vila Bela da Santíssima Trindade, est. Cachoeirinha (cascata), 17 km de Vila Bela da Santíssima Trindade, Parque Estadual Serra de Ricardo Franco, ca. 500 m, na margem direita do riacho, 16 Nov. 2005 (fl., fr.), (epitype, designated here, *P. Dias & R. G. Udulutsch 227* [sheets A and B], SPF). Figure 1.

Tree 5–15 m tall with brown hyaline pubescence of appressed hairs to 0.4 mm; branchlets 3–6 mm diam., greenish brown and puberulent when young, then glabrescent, with elliptic, pale lenticels. Leaves alternate, unifoliolate, with sessile leaflet; petiole subterete, slightly winged or not, 4–19 mm, the base slightly tumid, puberulent with appressed trichomes; leaflet blades elliptic, (3.1–)6.1–21.7 × 2.5–9.5 cm, acute to rounded at base, acuminate, with acumen obtuse to retuse at apex, the margin entire and flat

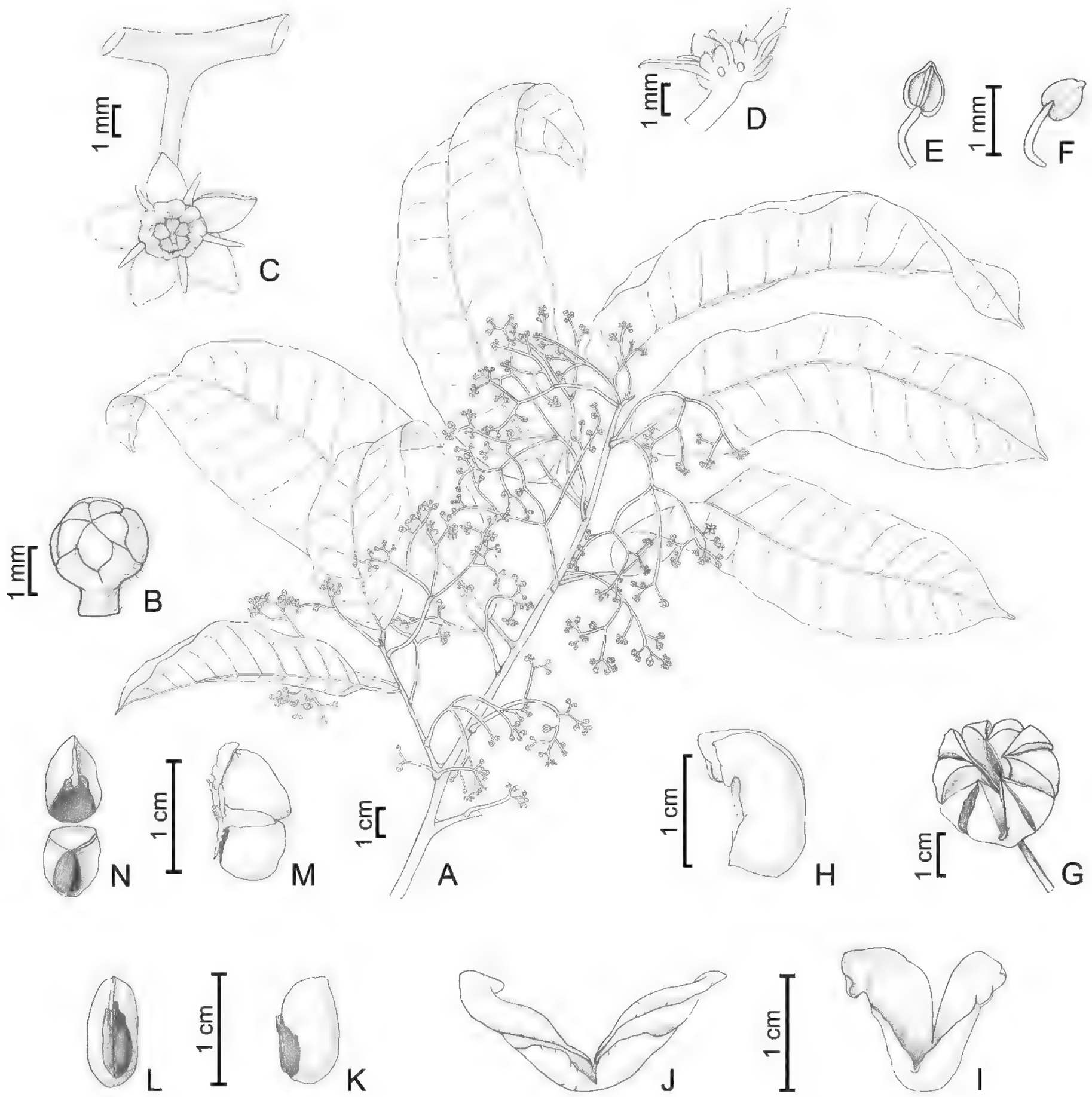

Figure 1. *Esenbeckia cowanii* Kaastra. —A. Flowering shoot. —B. Floral bud. —C. Flower at anthesis. —D. Flower in longitudinal section. Note that the ovary is higher than the disc. —E, F. Stamen at anthesis (E, dorsal view; F, ventral view). —G. Dehisced capsule; only the dry exocarp and mesocarp remain. —H, I. Endocarp detached from the mericarp before elastic dehiscence (H, lateral view; I, frontal view). —J. Endocarp elastically dehisced and detached from the mericarp; frontal view. K–N. Seeds. —K, L. One seed per locule (K, lateral view; L, frontal view). —M, N. Two seeds per locule (M, lateral view; N, frontal view). A–G drawn from the epitype *P. Dias & R. G. Udulutsch 227* (SPF). H–N drawn from *M. F. F. da Silva et al. 1304* (INPA). Drawings by R. G. Udulutsch.

(slightly subrevolute in silico), chartaceous, adaxially lustrous when fresh, puberulous to glabrous only on the midvein, abaxial surface paler and dull, puberulous to glabrous only on the midvein; venation brochidodromous, the primary and secondary veins impressed to plane above and prominent beneath. Inflorescences lateral, axillary or not, sometimes opposite to the leaf itself, along the branchlets, erect, paniculate, shorter than the leaves, 5–15 × 3–10 cm, densely puberulent with small, appressed trichomes to 0.4 mm; paraclades alternate, 1–5 cm, erect; bracts deciduous, 1.6–2.2 mm, triangular, densely puberulent; pedicels 4.35–15 mm, puberulent; bractlets (prophylls) deciduous, 1 per flower, ca. 1 mm, triangular, puberulent. Flowers 4.2–5 mm diam.; calyx lobes (4)5(6), persistent in young fruits, quincuncial, deltoid, 0.8–1.4 mm, the apex acute to attenuate, coriaceous, puberulent, the venation hyphodromous (visible only adaxially); petals (4)5, persistent in young fruits, quincuncial, widely spreading, ovate to slightly oblong, 2–2.7 × 0.9–1.2 mm, acute at apex, coriaceous, pale yellow to cream, puberulent on abaxial surface, glabrous on adaxial surface, the venation hyphodromous; filaments (4)5, sometimes persistent at young fruits, subulate, 1.6–2.05 mm, glabrous, reflexed after anthesis; anthers heart-shaped, versatile, ca. 0.8 mm including the small mucronate tip, glabrous, early deciduous; disc annular, (4)5-lobed, each lobe slightly 2-lobed, 1.8–2.1 mm diam., fleshy, provided with tiny glands,

Table 1. Major distinguishing features between *Esenbeckia cowanii* and *E. almawillia*.

Feature	*E. cowanii*	*E. almawillia*
Habit	tree	shrub
Inflorescence type	panicle	dichasium
Bracts and bractlets	deciduous	persistent
Flowers	protandric	non-protandric
Disc	shorter than the ovary	higher than the ovary
Capsule at maturity	rounded	angled (stellate)
Dorsal apophysis	deciduous, obtuse to rounded	persistent, curved, thornlike

puberulent, pale yellow; carpels (four)five, 0.9–1.2 mm high, adnate to the disc through the lower half and connate proximally, free and ellipsoid distally, the free part protruding ca. 0.1 mm beyond the disc, furnished with tiny glands, puberulent; ovules 2 per locule, collateral; style inserted proximally on the carpels but nearly completely free, 1.4–1.7 mm, glabrous; stigma clavate. Fruit 1 or 2 per infructescence, a depressed, 5-lobed capsule, 11.8–22 × 10.05–27 mm, puberulent, nerved externally when young, then becoming slightly smooth except for the deciduous, obtuse to rounded dorsal apophysis of each carpel, opening septicidally along the dorsal commissures from the apex down to 2–4 mm above the base or even reaching the very base, and loculicidally from the apex along the dorsal sutures up to an obtuse to rounded apophysis (2/3 to 1/2 from the base) and also along the entire frontal suture, slightly nerved to smooth on the inside of the mesocarp; endocarp smooth, ochre-yellow, hard, elastically (or explosively) dehiscent; seed 1 or 2 per locule (if 2, then superimposed), ovoid, 8.5–13 × 4.8–5.7 mm (if 1 seed) or 5.5–7.3 × 5.1–6 mm (if 2 seeds), beaked at the apex, the testa brown, the hilum narrow, elongate, from the apex to chalazal area, irregular in shape, dark brown to black; embryo not seen.

As stated by Kaastra (1982), *Esenbeckia cowanii*, together with *E. almawillia*, is included in *Esenbeckia* subg. *Lateriflorens* based on the lateral inflorescences. However, because Kaastra's description (1977) was based on only two collections, neither in flower, some observations were found to be misleading. For example, the petioles of *E. cowanii* are not always winged. We found winged and not winged petioles on the same specimen (the epitype presents both states). The inflorescences are sometimes opposite to the leaves but are not always axillary, as stated by Kaastra; the fruits do not become fully free at maturity (Fig. 1F). The free carpels seen by Kaastra were most likely an outcome of the pressing process (as can be seen on the type material), and there can be either one or two seeds per locule. As observed from herbarium specimens, *E. cowanii* is often misidentified as *E. almawillia*. However, *E. cowanii* has several distinguishing features not shared by *E. almawillia*, as summarized in Table 1.

Habitat and distribution. *Esenbeckia cowanii*, previously known only from French Guiana, has a much wider distribution in South America, particularly in Brazil, where it occurs in Acre, Amapá, Amazonas, Pará, Rondônia (northern Brazil), and Mato Grosso (central Brazil). In Acre, Amazonas, and Rondônia, the taxon was collected in rainforests (terra firme forests) with canopies to 30 m tall; in Pará, it was found in rainforests and along the forest-savanna edges of the Carajás Range (southern Pará); in Mato Grosso, it was collected in semideciduous forests at the base of the Parecis Range.

Additional specimens examined. BRAZIL. **Acre:** Brasiléia, est. para Assis Brasil, Km. 5, *C. A. Cid 3130* (NY); Cruzeiro do Sul, BR-364, Km. 42, *A. Rosas Jr. et al. 259* (INPA, MG, NY); basin of Rio Juruá, Rio Juruá-Mirim, Igarapé Humaitá, *D. C. Daly et al. 11643*; Xapuri, est. Rio Branco–Brasiléia, Km. 220, *W. W. Filho & D. F. Coelho 20* (INPA). **Amapá:** Calçoene, BR-156, vic. of government rd. camp Carnot, *S. A. Mori et al. 17342* (NY). **Amazonas:** Manaus, est. Z. F.–1, Km. 9, *L. Coelho et al. 789* (INPA). **Mato Grosso:** Vila Bela da Santíssima Trindade, Caminho da cachoeira de Vila Bela, *L. Carreira et al. 729* (INPA, MG, NY); est. para Cachoeirinha (cascata), 17 km de Vila Bela da Santíssima Trindade, Parque Estadual Serra de Ricardo Franco, *P. Dias & R. G. Udulutsch 226, 284, 285* (HRCB, SPF), *286* (HRCB, NY, SPF). **Pará:** Marabá, Carajás, Serra Norte, área explor. minério N-1, *M. F. F. da Silva et al. 1304* (INPA, MG); *A. S. L. da Silva et al. 2005* (INPA, MG); mina de manganês, *J. G. S. Maia et al. 11* (MG); Serra Norte, acampamento Azul, *R. Secco et al. 309* (MG, NY); Serra Norte, 6 km on rd. SE of AMZA camp N-1, *C. R. Sperling et al. 5747* (INPA, MG, NY); 1–4 km along rd. from camp Azul toward AMZA camp N-1, *C. R. Sperling et al. 5852* (F, INPA, MG, NY), *D. C. Daly et al. 1765* (INPA, MG, NY); mina de ferro do N1, *N. A. Rosa et al. 5140* (MG); margem da estrada entre N-1 e Serraria, Km. 12, *N. T. Silva & B. S. Ribeiro 3644* (IAN); arredores da Serraria, *M. G. Silva & R. P. Bahia 2967* (MG, NY); N1, est. do Manganês, *O. C. Nascimento & R. P. Bahia 925* (MG); margem da estrada do N-13, *N. T. Silva & B. S. Ribeiro 3589* (IAN). **Rondônia:** Jaru, BR-364, 28.4 km de Ouro Preto d'Oeste, então 4.5 km na Linha 632, Faz. Sr. Zuza, *P. Dias & R. G. Udulutsch 289* (HRCB, SPF).

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Coniogramme bashanensis (Pteridaceae), a New Fern Species from Shaanxi, China

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ABSTRACT. A new species, *Coniogramme bashanensis* X. S. Guo & B. Li (Pteridaceae), is described and illustrated. This new fern species was collected from the northern slope of Mt. Bashan in Langao County of Shaanxi Province, China. It is similar to *C. wilsonii* Hieron. in its perennial habit and frond veins that are 1- or 2-forked, occasionally connected to form one or two areoles. These fern taxa differ by the shape of the frond base. Pinnules are asymmetrically cuneate or hastate, or divided with a small auriculate segment in *C. bashanensis*; pinnules are cordate or rounded to cuneate, also unevenly so, in *C. wilsonii*.

Key words: China, *Coniogramme*, IUCN Red List, Mt. Bashan, Pteridaceae, Shaanxi.

The genus *Coniogramme* Fée (Pteridaceae) consists of ca. 50 species, distributed mainly in tropical and subtropical regions of Asia, few of which are distributed in Africa and South America (Wu & Ching, 1991). About 39 species of *Coniogramme* were documented from China in the *Flora Reipublicae Popularis Sinicae* (Shing, 1990), mainly in the Changjiang River area and southern and southwestern China. Recently, in the course of exploration in the Bashan Mountains, several specimens of *Coniogramme* were collected. However, these specimens featured either hastate pinnules or were divided with a small auricular segment at the pinnule base, which distinctly differed from those of other *Coniogramme* species. After careful examination of other morphological characters, we determine this to be a new species of *Coniogramme*, which is described herein.

Coniogramme bashanensis X. S. Guo & B. Li, sp. nov. TYPE: China. Shaanxi: Langao, Yihe town, Shiziwan village, 32°16′27″N, 109°4′13″E, 1250 m, 15 Oct. 2004, *Y.-s. Chen, Z.-h. Wu, B. Li & X.-s. Guo 1965* (holotype, WUK; isotype, WUK). Figures 1–3.

Diagnosis. *Coniogramme bashanensis* X. S. Guo & B. Li is most similar to *C. wilsonii* Hieron., but the former has oblong-lanceolate pinnules with a rounded-cuneate or hastate base or the base divided with a small auricular segment, and sparsely short hairs on both surfaces, while the latter has lanceolate pinnules somewhat cordate or rounded-cuneate and glabrous on both surfaces.

Herbs perennial, 60–90 cm tall; stems basally decumbent; scales dark brown, lanceolate; stipes 40–60 cm, ca. 5 mm diam., gray-brown or stramineous; base with sparse, brown, linear-lanceolate scales; lamina 30–40 × ca. 25 cm, broadly ovate, bipinnate; lateral pinnae in 4 to 5 pairs, opposite, oblique and slightly incurved, basal pair largest, 15–20 × ca. 10 cm, petioles 3–4 cm, pinnate; lateral pinnules in 1 to 3 pairs, 10–15 × 2.5–4 cm, oblong to lanceolate, apex acuminate and caudate, base rounded to cuneate or hastate, shortly stalked or sessile; medial pinnae simple, oblong or lanceolate, 15–18 × 3–4 cm, petiolules 2–20 mm, otherwise similar to lateral pinnules, hastate or divided with a small auricular segment at base, unequal; terminal pinnules larger than adjacent pinnules, petiolules 1.8 cm, oblong to lanceolate, apex acuminate and caudate, base rounded to cuneate, unequal; fronds herbaceous when dry, adaxially dark green, abaxially gray-green, sparsely short pubescent; pinnae and pinnules serrulate with minute, slightly irregular, deltate teeth; veins 1- or 2-forked, occasionally connected to form 1 or 2 areoles; the veinlets end in hydathodes; hydathodes slightly thickened, linear, reaching to base of teeth. Sori continuous along pinnule veins, extending to 6 mm from the pinna margin.

Distribution and habitat. *Coniogramme bashanensis* is known only from Langao County in Shaanxi Province, China. Langao County is located in the middle of the northern slope of Mt. Bashan. The new species occurs in secondary forest, as well as along trails in the forest. The primary vegetation of the type locality is deciduous broad-leaved forest or mixed temperate coniferous and broad-leaved forest, and the dominant species are *Quercus aliena* Blume var. *acutiserrata* Maxim. ex Wenz., *Pinus tabuliformis* Carrière, and *Robinia pseudoacacia* L.

IUCN Red List category. *Coniogramme bashanensis* is known only from one population with mature individuals fewer than 150. Its distributional area is smaller than 100 km^2. The only known population of *C. bashanensis* is severely threatened by developing tourism and overgrazing in the area. Its conservation

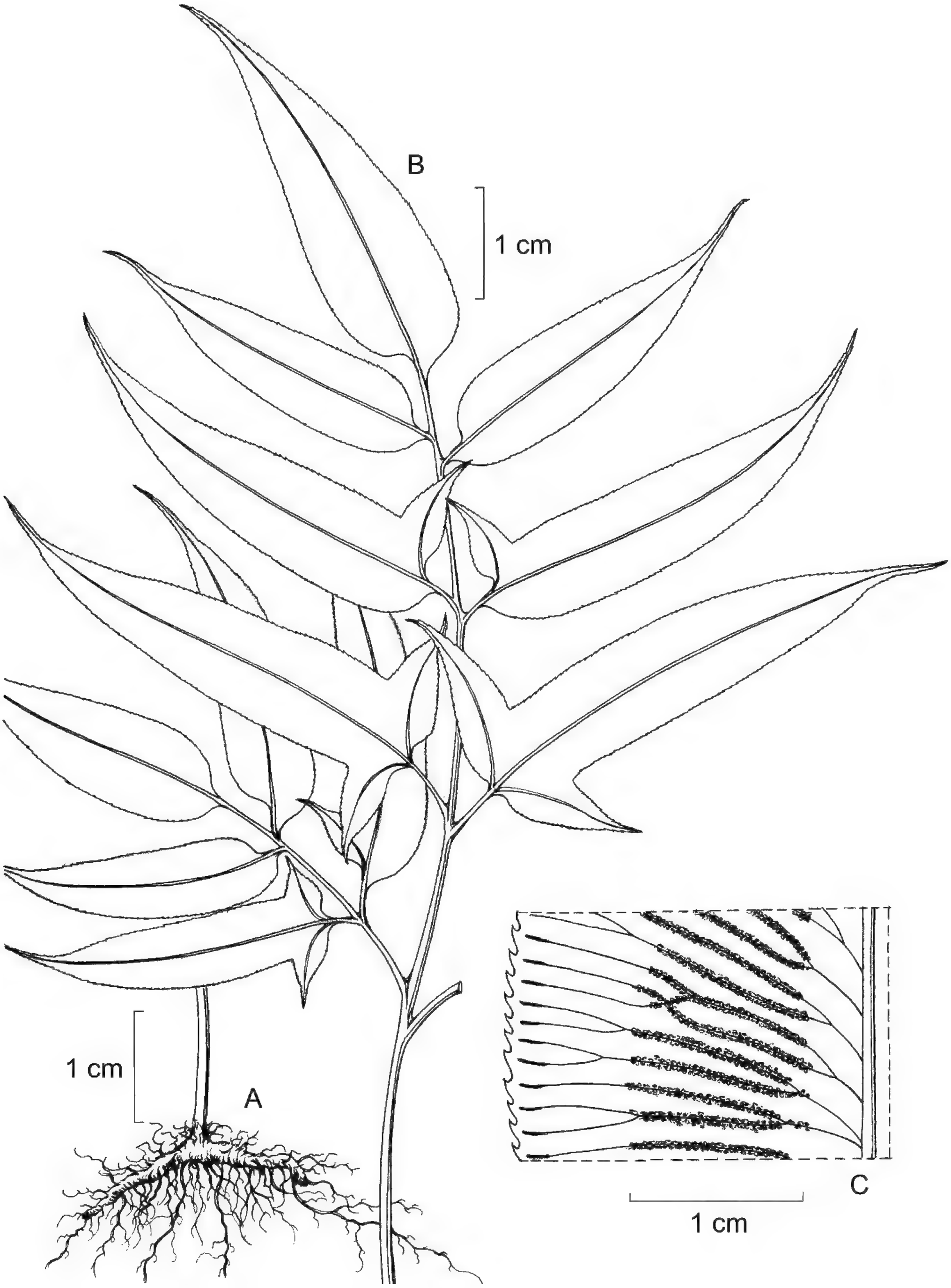

Figure 1. *Coniogramme bashanensis* X. S. Guo & B. Li. —A. Rhizome. —B. Frond. —C. Portion of leaf showing the free veinlets that end in hydathodes as well as the sori continuously distributed along veins. Drawn from the holotype, *Y.-s. Chen, Z.-h. Wu, B. Li & X.-s. Guo 1965* (WUK).

status is evaluated as Critically Endangered (CR), based on current information and according to IUCN criteria (IUCN, 2008). We believe there is an urgent need to protect this species.

Taxonomic relationship. *Coniogramme bashanensis* belongs to *Coniogramme* on the basis of the fairly large fronds that are bipinnate, the broadly ovate lamina, with the pinnules serrulate, the pinnule

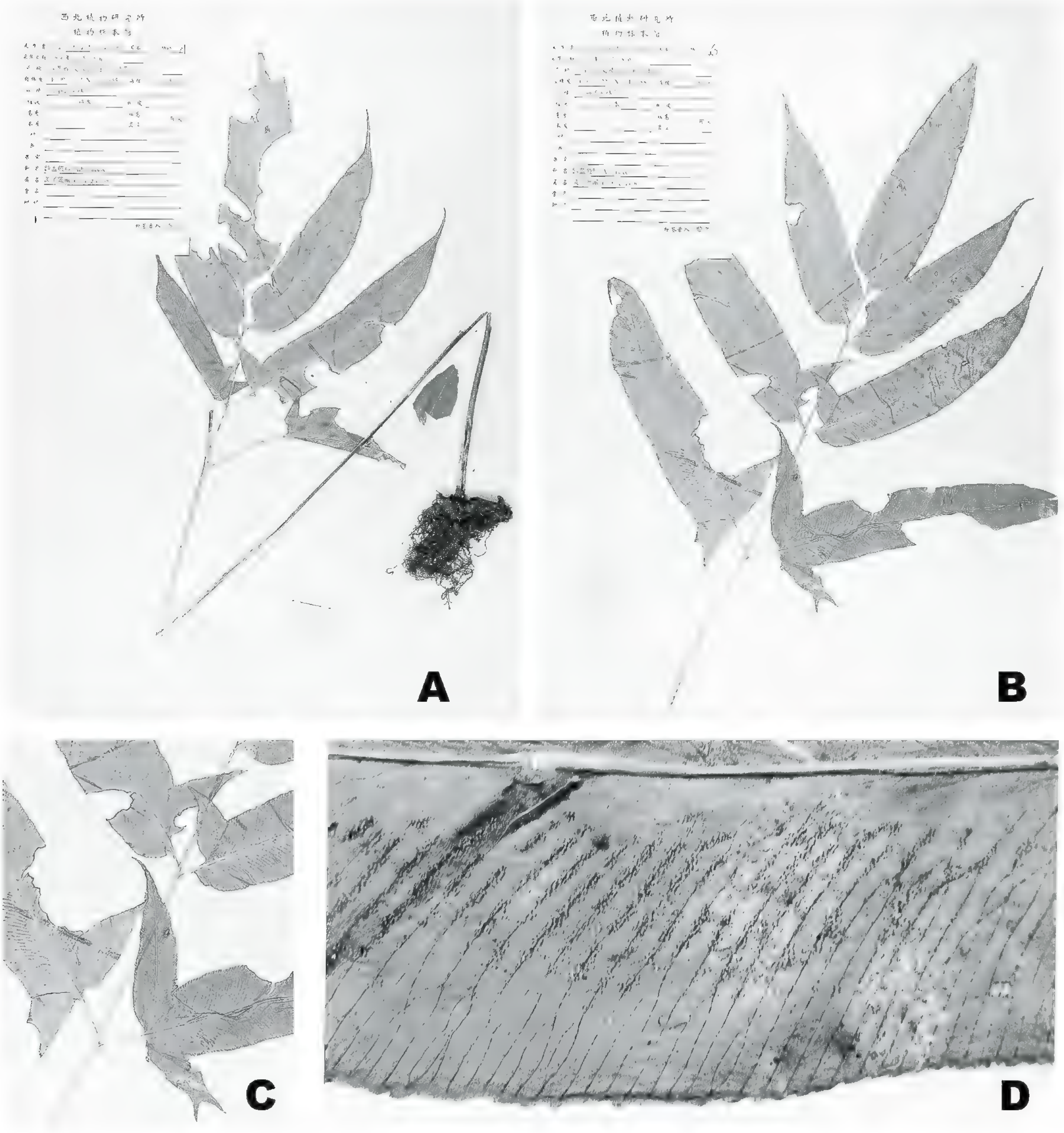

Figure 2. *Coniogramme bashanensis* X. S. Guo & B. Li. —A. Holotype sheet with frond and rhizome. —B. Isotype sheet with frond. —C. Close-up of lower portion of isotype. —D. Portion of isotype magnified to show the free veins ending in hydathodes, with the sori continuous along veins. Photographs taken from the type, *Y.-s. Chen, Z.-h. Wu, B. Li & X.-s. Guo 1965* (WUK).

veins that are free or forked once or twice, or rarely anastomosing without any included, free veinlets. The veinlets end in hydathodes and are attached at sori that are continuously distributed along the veins. *Coniogramme bashanensis* is very distinct from other known species of *Coniogramme* in China and can easily be recognized by having four to five pairs of lateral pinnae. *Coniogramme bashanensis* is otherwise similar to *C. wilsonii* in general morphology. Both species have 1- or 2-forked veins, forming a few discontinuous areoles along each side of costae. The new species differs from the latter by its pinnules oblong to lanceolate, the base unequal, rounded to cuneate, hastate or divided with a small auricular segment, and sparsely short hairs on both lamina surfaces. As for *C. wilsonii*, its pinnules are lanceolate, also with an unequal base, somewhat cordate or rounded to cuneate, and both lamina surfaces are glabrous. *Coniogramme intermedia* was also found near the distributional area of *C. bashanensis*, but the latter species has pinnules with a rounded to cuneate base and veins that do not form

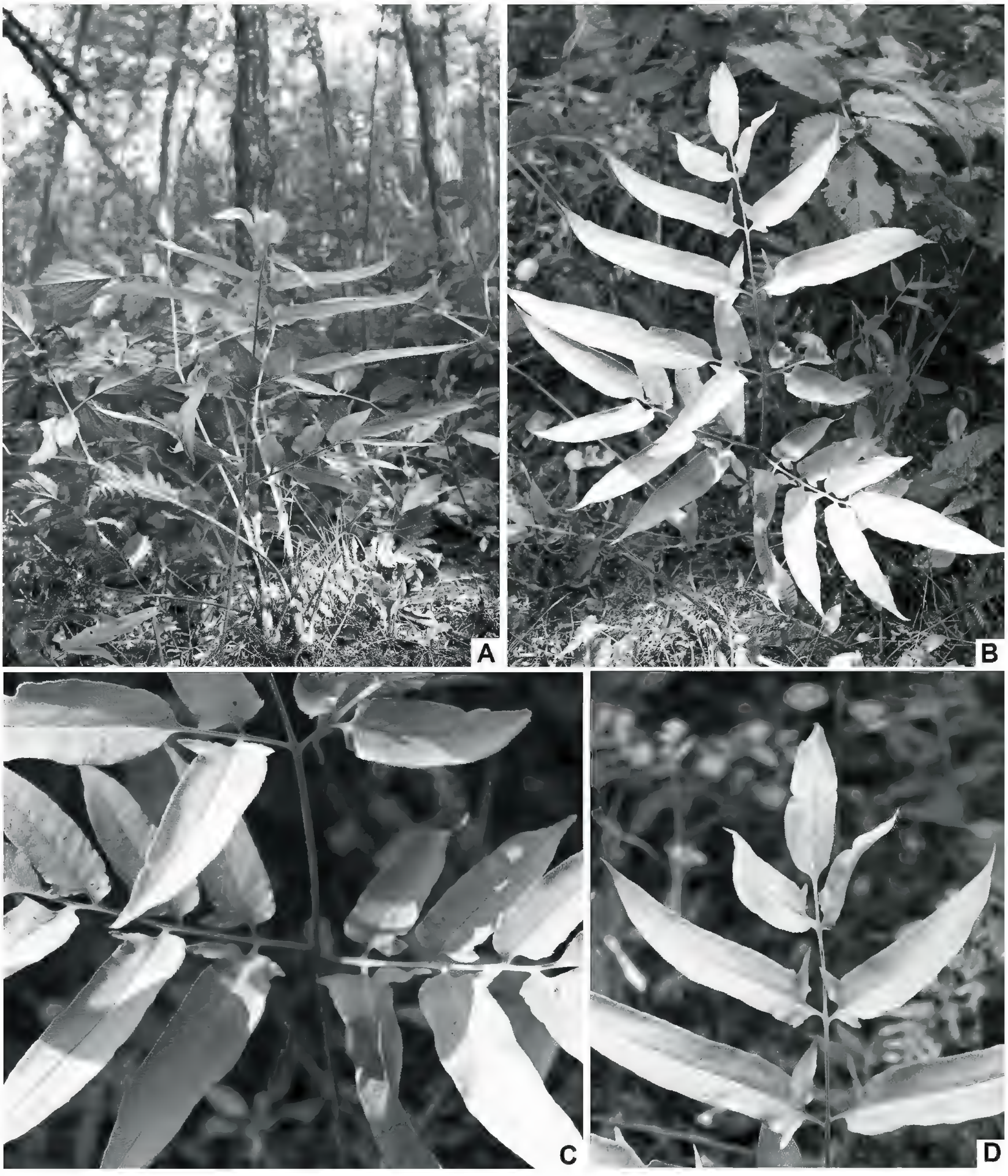

Figure 3. *Coniogramme bashanensis* X. S. Guo & B. Li. —A. Plant habit. —B. An intact plant viewed from above. —C, D. Close-up portions of the plant. Photographed at the type locality by X. S. Guo, with this plant then collected as the paratype, *X.-s. Guo & J.-z. Sun 2012-2* (MO, WUK).

discontinuous areoles along each side of the costae. *Coniogramme* has its greatest diversity in China, Japan, Korea, extending into the Himalayas, Southeast Asia, Africa, and North America (Wu & Ching, 1991).

Paratype. CHINA. **Shaanxi:** Langao, Yihe town, Shiziwan village, 1250–1270 m, 11 Aug. 2012, *X.-s. Guo & J.-z. Sun 2012-2* (MO, WUK).

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A New Alpine Species of *Nepeta* sect. *Capituliferae* (Labiatae) from Northwestern Iran

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Abstract. A new species, *Nepeta sahandica* Noroozi & Ajani (Labiatae), is described and illustrated from the high altitudes of the Sahand Mountains in northwestern Iran. Morphological differences of this species from its closest relatives in *Nepeta* L. sect. *Capituliferae* (Benth.) Pojark., *N. lasiocephala* Benth. and *N. monocephala* Rech.f., are discussed. These species differ mainly in their respective habit, basal and stem leaves, indumentum, and character of bract and calyx. The new species is restricted to the subnival vegetation zone, associated with unstable scree grounds. *Nepeta sahandica* is classified as Critically Endangered (CR), based on IUCN Red List criteria.

Key words: Iran, IUCN Red List, Labiatae, *Nepeta*, Sahand Mountains.

The genus *Nepeta* L. (Labiatae) is an Irano-Turanian element and one of the largest genera in Iran with ca. 80 species, of which almost 60% are endemic or subendemic (Rechinger, 1982; Jamzad, 2009). It is the second most numerous genus represented in the alpine habitats of Iran (21 species) with an 86% endemic or subendemic rate (Noroozi et al., 2008). Four *Nepeta* species have been previously recorded for the subnival-nival flora of Iran (Noroozi et al., 2011). The high rate of endemism of *Nepeta* in Iranian mountains might represent evidence of active speciation in the region.

In the *Flora Iranica*, the genus *Nepeta* was divided into 13 sections, with *Nepeta* sect. *Capituliferae* (Benth.) Pojark. characterized by its capitate, terminal or axillary inflorescences (Rechinger, 1982). Since the publication of *Flora Iranica*, two new species of *Nepeta* sect. *Capituliferae*, *N. minuticephala* Jamzad and *N. natanzensis* Jamzad, have been described (Jamzad, 1999, 2006), increasing the number of species in this section to eight (Jamzad, 2009). With the inclusion of the new species here described, the number of species in the section reaches nine. All species in this section are either endemics or localized endemics at high altitudes of the Zagros and Alborz mountain ranges (Rechinger, 1982; Jamzad & Assadi, 1984; Jamzad, 1992, 1998, 1999, 2006; Delghandi, 1993; Jamzad et al., 2003), but none have extended to the high altitudes of the Azerbaijan region in northwestern Iran, with the exception of the new species described in this paper.

The Sahand refers to a complex of inactive volcanic mountain peaks in northwestern Iran, east of Lake Urumiyeh (Urmia) and south of Tabriz City, reaching 3707 m.s.m. at its highest summit (Fig. 1). The Sahand is surrounded by the Alborz, Zagros, Anatolia, and Caucasus mountain ranges and is located in the southernmost corner of the Caucasian region, one of the world's 25 biodiversity hotspots (Myers et al., 2000). Snow remains on the northern slopes as snowbeds until mid- to late summer, and the subnival zone in this region begins ca. 3500 m.s.m.

The new species was discovered during fieldwork by the first author in the high altitudes of the Sahand in early August 2010. To identify associated species and ecological characters of the habitat, several phytosociological relevés (100 m^2) were sampled from the habitat of the new species, following the methodology of Braun-Blanquet (1964). Morphological characters of this species, such as the plant habit, root system, and the fresh color of the corolla, were investigated directly in the field.

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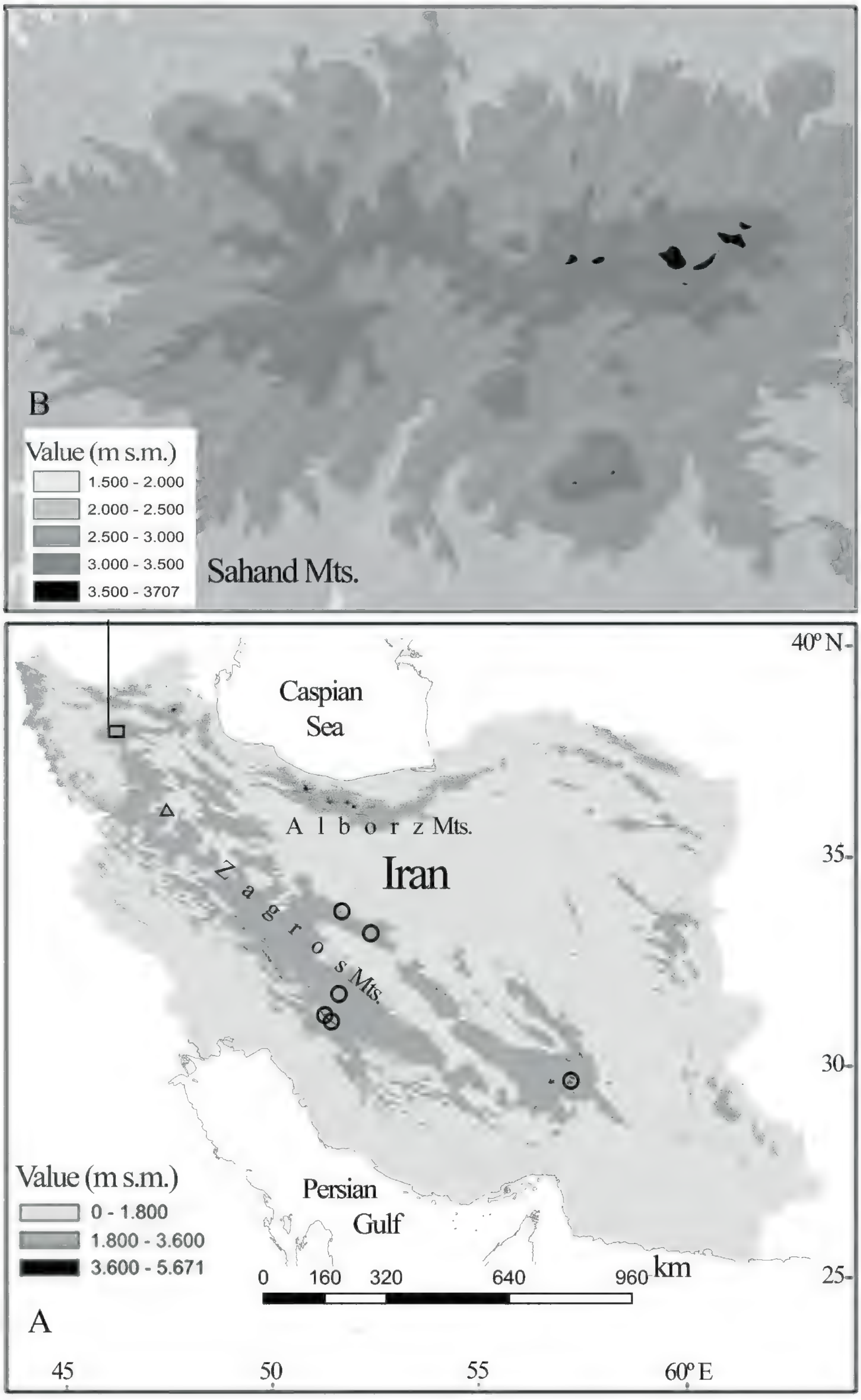


Figure 1. —A. Topographic map of Iran, indicating the known distribution of *Nepeta sahandica* Noroozi & Ajani (box), *N. monocephala* Rech.f. (triangle), and *N. lasiocephala* Benth. (circle). —B. Topographic close-up of the Sahand Mountains, where the new species *N. sahandica* is restricted to altitudes above 3500 m.s.m. (darkest shading).

Nepeta sahandica Noroozi & Ajani, sp. nov. TYPE: Iran. East Azerbaijan: Sahand Mtns., 37°44′03″N, 46°29′59″E, 3500–3630 m.s.m., on scree grounds, 31 July 2011, *J. Noroozi 2598* (holotype, TARI; isotype, W, WU). Figure 2A–F.

Diagnosis. The new species *Nepeta sahandica* Noroozi & Ajani differs from *N. monocephala* Rech.f. and *N. lasiocephala* Benth. by the stem leaves restricted mostly to the lower half of the stem and by the velutinous calyces and leaves. The calyces (6–8 mm) are shorter than those of *N. lasiocephala* (8.5–9 mm), and the lower tooth of the calyx is shorter (2–2.5 mm) than those of both species (ca. 3 and ca. 5 mm in *N. monocephala* and *N. lasiocephala*, respectively). In *N. sahandica*, the bracts are only ciliate and larger (7–8 × 1.5–2 mm) versus villous and smaller (3–4 × 0.5–1 mm) in *N. monocephala*.

Perennial, lignified at the base, with multiple, ascendent stems that are densely glandular; root extended, to 30 cm or more; stems 15–24 cm tall, 1.5–2 mm wide at base, not branched or with thin and short branches 4.5–6 cm, all stem parts densely covered with capitate glandular trichomes intermixed with a few simple, nonglandular, multicelluar trichomes; stems green shading to violet in upper portions of the stem close to the flower heads; stem internodes associated with the lowermost leaves 1–3 cm, uppermost internodes 4.5–9.5 cm. Leaves mostly restricted to the lower half of the stems; basal leaves petiolate, petioles 9–18 mm; blades 6–13 × 7–13 mm, widely ovate to triangular, bases truncate to cordate, margin crenate, apex obtuse; abaxial lamina surfaces with prominent veins, covered with capitate glandular trichomes intermixed with sparse to moderate simple, nonglandular, multicellular trichomes, velutinous, adaxial lamina surfaces with few capitate, glandular trichomes, but with dense, simple, nonglandular, multicellular trichomes; stem leaves subsessile, blades 6–14 × 4–8 mm, ovate to oblong, bases cuneate, margin denticulate, apex acute. Inflorescences capitate and terminal, 14–18 × 14–18 mm; pedicels ca. 1 mm long; bracts linear, 7–8 × 1.5–2 mm, violet in middle portion, 1 vein evident dorsally, with sparse, simple, nonglandular, multicellular trichomes, velutinous, margin ciliate. Flowers with the calyx 6–8 × 1 mm, tubular, throat oblique, with capitate glandular and dense, simple, nonglandular trichomes, velutinous thoughout, violet in at the least upper and middle portions; calyx teeth lanceolate, acuminate or acute, with the lower tooth 2–2.5 mm long, the upper tooth 1.5–2 mm long; corolla tubular, blue-violet, 12–13 mm, the corolla tube exerted from the calyx, the outer surface covered by short, simple, nonglandular trichomes, dorsal portions of the upper lip densely covered with capitate glandular and simple nonglandular trichomes. Fruit as nutlets 2–2.5 × 0.9 mm, brown, oblong to elliptic, with 1 prominent median keel.

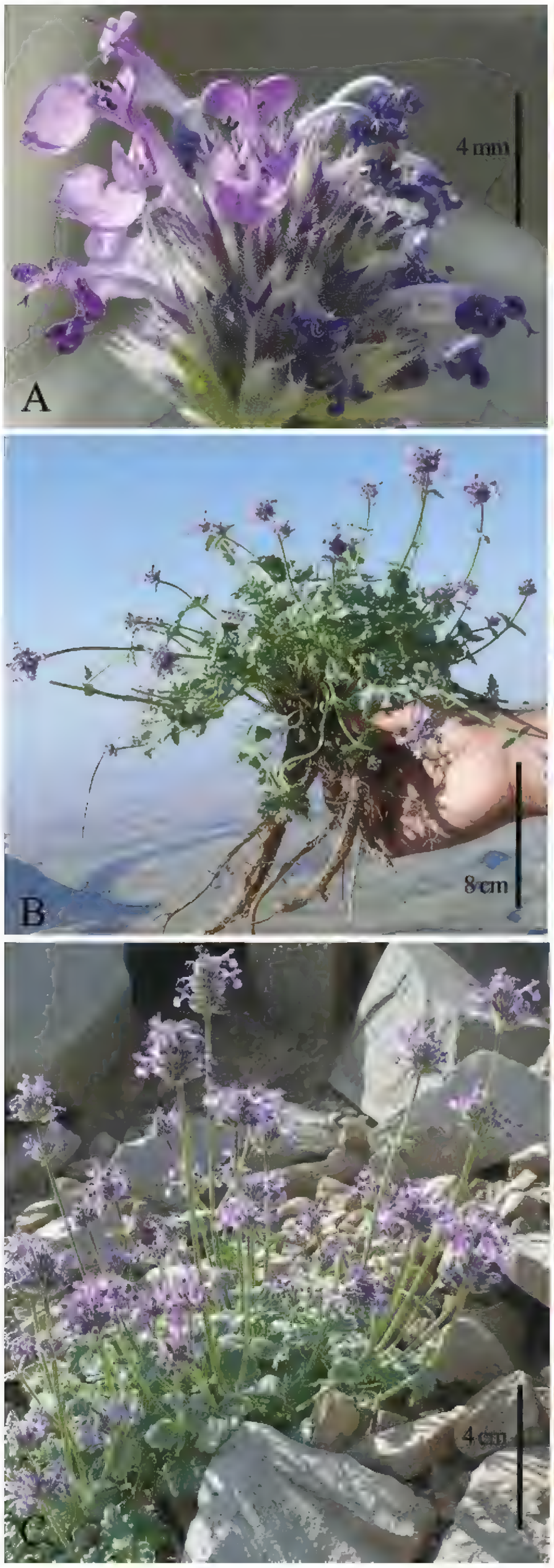
Distribution and habitat. *Nepeta sahandica* is known only from the subnival zone of the northern slopes of the Sahand in northwestern Iran, ranging from altitudes of 3500–3630 m.s.m. The new species is adapted to unstable scree grounds with a high percentage of scree cover (ca. 65%) and steep slope inclination, ca. 30°–45°. This species thus belongs to the subnival-nival flora of Iran, a zone with a very high rate of endemism and with narrow geographical distributions (Noroozi et al., 2011). A selection of seven phytosociological relevés from the plant community of the new species, following the methodology of Braun-Blanquet (1964), is given in Table 1. The vegetation cover of the relevés was ca. 15%, and species richness was ca. 10 species per relevé. For more information about the phytosociological aspects of this plant community, see Noroozi et al. (2013).

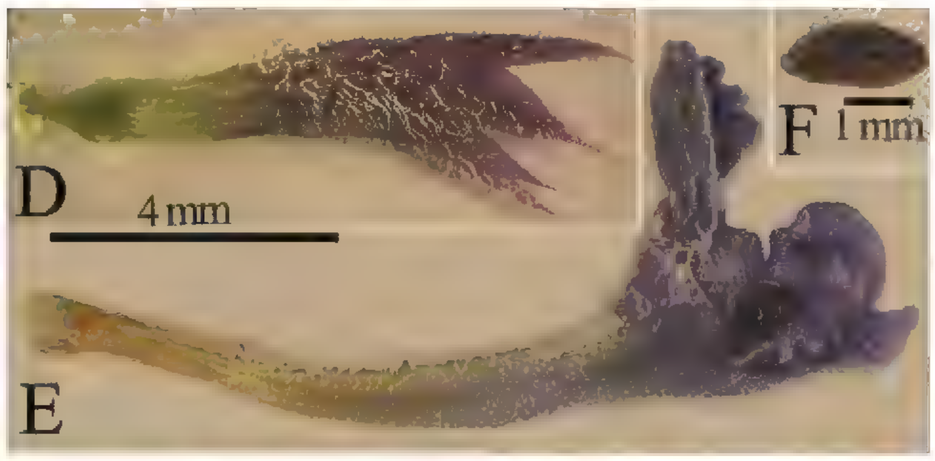
IUCN Red List category. Vegetation studies in the high alpine and subnival zones of the Sahand Mountains show that the new species is restricted to the highest altitudes, above 3500 m.s.m., and that *Nepeta sahandica* may be very sensitive to global warming as there is no alternative low-temperature habitats for upward migration. The Sahand Range is also under high pressure from summer overgrazing by goats and sheep, whose milk is used to produce the region's famous cheese. In spite of the known high rate of local endemism in these mountains, there are no appropriate control and protection plans. Therefore, *N. sahandica* is assessed as Critically Endangered (CR), according to IUCN Red List criteria (IUCN, 2001).

Phenology. The new species has been seen in flower from mid-July to mid-August.

Etymology. The epithet of the new species refers to its type locality in the Sahand Mountains.

Taxonomic affinities. The presumed closest relatives of the new species include *Nepeta monocephala* and *N. lasiocephala*, and both are recorded from the Zagros mountain ranges, extending to the south and southeast of the Sahand (Fig. 1). *Nepeta monocephala* is known only from the type collection in northern Zagros, collected in 1968 from the Chang Almas Mountain at altitudes between 2200 and 2500 m.s.m. (Rechinger, 1982); it has not been recorded or collected since then. The description of *N. mono-*





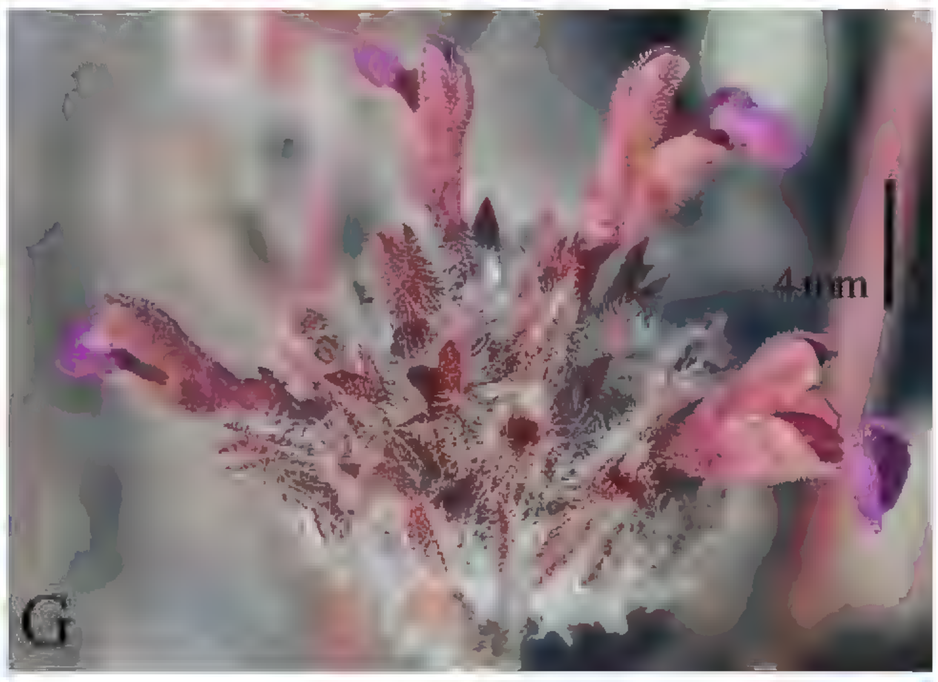


Figure 2. A–F. *Nepeta sahandica* Noroozi & Ajani. —A. Inflorescence. —B, C. Entire plant. —D. Calyx. —E. Corolla. —F. Nutlet. G–J. *Nepeta lasiocephala* Benth. —G. Inflorescence. —H, J. Entire plant. Photos A–C taken by J. Noroozi in the Sahand, 3550 m.s.m.; photos D–F taken by Y. Ajani from the TARI holotype, *J. Noroozi 2598* (TARI); photos G–J taken by J. Noroozi and Y. Ajani in the Hezar Mountains, 4450 m.s.m.

Table 1. Species composition of the habitat for *Nepeta sahandica*, based on seven phytosociological relevés from the subnival zone of the Sahand, at the northern slope of its highest peak, on Kamal Daghi (3707 m.s.m.), and for *N. lasiocephala*, based on two relevés from the subnival zone of the Hezar Mountains, on the northern slope of its highest peak (4465 m.s.m.). The symbols show the cover-abundance of each species, according to the method of Braun-Blanquet (1964), where 2 = 5%–25%; 1 = 1%–5%; + = < 1%; and r = < 5 cm². Each relevé area is 100 m².

	Sahand							Hezar	
Relevé number	1088	1089	1090	1091	1092	1093	1095	938	939
Altitude (m.s.m.)	3538	3550	3553	3567	3571	3592	3622	4455	4443
Slope aspect	N	N	N	N	N	N	NE	NE	NE
Slope inclination (degrees)	40	45	40	45	45	35	30	20	20
Plant cover (%)	20	15	15	10	10	15	30	5	10
Scree coverage (%)	45	40	40	85	80	60	75	92	85
Solid rock (%)	30	35	40	0	0	15	0	2	3
Bare ground (%)	5	10	5	5	10	10	5	1	2
Species richness	16	9	11	8	9	8	13	7	11
Nepeta sahandica	**1**	**1**	**1**	**2**	**1**	**1**	**1**		
Didymophysa aucheri Boiss.	1	1	1	1	1	1	1		
Bromus tomentosus Trin.	1	1	1	1	1	2	2		
Ziziphora clinopodioides Lam.	1	1	1	1	1	1	1		
Senecio taraxacifolius (M. Bieb.) DC.	1	1	1	+	1	—	1		
Poa araratica Trautv.	1	1	1	1	—	+	+		
Festuca alaica Drobow	1	—	1	+	1	1	1		
Dracocephalum aucheri Boiss.	1	2	1	—	+	1	—		
Arabis caucasica Willd.	+	—	+	—	—	+	1		
Galium hyrcanicum C. A. Mey.	—	—	+	+	1	—	2		
Saxifraga sibirica L.	+	+	—	—	1	—	—		
Pedicularis caucasica M. Bieb.	+	—	—	—	—	—	+		
Erysimum gelidum Bunge	+	—	—	—	—	—	1		
Erigeron caucasicus Steven	+	—	—	—	—	—	1		
Helichrysum psychrophilum Boiss.	—	—	—	—	—	—	+		
Crepis frigida (Boiss. & Balansa) Babc.	+	—	+	—	—	—	—		
Nepeta menthoides Boiss. & Buhse	1	—	—	—	—	—	—		
Thymus kotschyanus Boiss. & Hohen. ex Boiss.	+	—	—	—	—	—	—		
Artemisia L., sp. indet.	—	r	—	—	—	—	—		
Nepeta lasiocephala								**1**	**1**
Astragalus melanodon Boiss.								1	1
Artemisia persica Boss.								+	1
Asperula glomerata (M. Bieb.) Griseb. subsp. *condensata* (Ehrend.) Ehrend.								+	1
Potentilla nuda Boiss.								1	+
Scrophularia subaphylla Boiss.								+	+
Gagea alexii Ali & Levichev								+	—
Ranunculus eriorrhizus Boiss. & Buhse								—	1
Senecio subnivalis Y. Ajani, J. Noroozi & B. Nord.								—	+
Veronica kurdica Benth. subsp. *filicaulis* (Freyn) M. A. Fisch.								—	+
Psychrogeton alexeenkoi Krasch.								—	+
Silene daenensis Melzh.								—	+

cephala is thus based only on the type specimens in the W and IRAN herbaria. We have seen live plants of *N. lasiocephala* (Fig. 2G–J) on the highest summit of the Hezar Mountains (4465 m.s.m.) in southern Iran, and we have also examined the type specimens of both *N. lasiocephala* and *N. monocephala* in the W herbarium. These three species share several morphological characters. The basal leaves of these species are identical in shape, margin, apex, and basal parts. The major morphological differences between these species include the plant habit, stem trichome types and indumentum, leaf sizes and indumentum, bract sizes, and calyx sizes and indumentum, as well as the corolla shape and length

Table 2. Morphological differences among *Nepeta sahandica*, *N. monocephala*, and *N. lasiocephala*.

Characters	*N. sahandica*	*N. monocephala*[1]	*N. lasiocephala*[2]
Habit	ascendant	straight	ascendant or deflexed
Stem trichome types; indumentum	dense capitate glandular trichomes intermixed with a few simple nonglandular multicellular ones; densely glandular	subsessile glandular trichomes intermixed with simple nonglandular multicellular ones; basally villous, glabrescent above	dense capitate glandular trichomes intermixed with simple nonglandular multicellular ones; villous
Basal leaf sizes (mm)	6–13 × 7–13	15–20 × 15–20	5–10 × 5–10
Stem leaf sizes (mm), position, shape, margin	6–14 × 4–8, mostly in lower half, but some also in upper half of the stem, leaves ovate to oblong, denticulate	2–4 × 0.5–1, stems nearly naked (subnude), leaves basal, lanceolate, denticulate, or entire	5–10 × 5–10, leaves equally distributed, ovate, crenate
Leaf indumentum	velutinous, denser adaxially than abaxially	densely villous, more so abaxially than adaxially	densely lanate, more so abaxially than adaxially
Bract size (mm), indumentum at margin	7–8 × 1.5–2, glabrate, ciliate	3–4 × 0.5–1, villous	8 × 2.5–3, villous in upper portions
Calyx indumentum	velutinous	villous	villous in upper portions
Calyx size (mm)	6–8 × 1	7–8 × 1.5–2	8.5–9 × 1
Calyx lower tooth size (mm)	2–2.5	3	5
Calyx upper tooth size (mm)	1.5–2	1.5–2	2.5–3
Corolla shape	tubular	tubular	funneliform
Corolla length (mm)	12–13	12–13	11
Nutlet shape	oblong to elliptic	ovate to elliptic	oblong
Nutlet size (mm)	2–2.5 × 0.9	1.3 × 0.8	1.9 × 0.9

[1] Data according to Rechinger (1982) and isotype *Iranshahr & Dezfoulin E13207* (W).
[2] Data according to Rechinger (1982), isotype *Kotschy 757* (W), and field studies.

(see Table 2). Nutlet shape and size are also significant characters for the taxonomy of the tribe Nepeteae (Budantsev, 1993; Budantsev & Lobova, 1997). Distributional and ecological characters of the three similar species are compared in Table 3. *Nepeta natanzensis* is another member of *Nepeta* sect. *Capituliferae*, but it differs greatly from the discussed species in its clearly lignified caudex and basal parts of the stem and its spine-shaped calyx.

The habitat of *Nepeta lasiocephala* was studied in the Hezar Mountains, in southern Iran, with sampling of two phytosociological relevés. Table 1 compares the ecology and species composition of this species with *N. sahandica*, showing the data of relevés. There is no information available for the habitat of *N. monocephala* because this species is known only from the type collection and has not been recorded since, despite some general, although not detailed, botanical surveys by local botanists (H. Maroofi, pers. comm.). The type locale for *N. monocephala* on the Chang Almas Mountain has not been botanically well explored, and its precise location is not known. It is likely that this species may be found again with botanical investigation. There is no doubt that this species is very rare and locally endemic, and further botanical exploration of its distribution, habitat, and ecology is highly recommended.

Table 3. Distributional and ecological characters associated with *Nepeta sahandica*, *N. monocephala*, and *N. lasiocephala*.

Characters	*N. sahandica*	*N. monocephala*	*N. lasiocephala*
Geographical distribution	Sahand Mtns.	northern Zagros (Chang Almas Mtn.)	central, south, and southeastern Zagros
Altitudinal distribution (m.s.m.)	3500–3630	2200–2500	2000–4465
Habitat	scree grounds of subnival zone	no data	scree grounds of subalpine to subnival zones
Threat status (IUCN Red List criteria)	Critically Endangered (CR)	Data Deficient (DD) (its presence has not been recorded for 44 years)	Near Threatened (NT)

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Generic Status and Lectotypifications for *Gymnospora* (Polygalaceae)

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Abstract. *Polygala* sect. *Gymnospora* Chodat (Polygalaceae) is recognized at the generic rank based on recent phylogenetic evidence as *Gymnospora* (Chodat) J. F. B. Pastore with two new combinations, *G. blanchetii* (Chodat) J. F. B. Pastore and *G. violoides* (A. St.-Hil. & Moq.) J. F. B. Pastore. We also present a taxonomic key for species identification and argue that *P. blanchetii* Chodat should not be treated as a synonym of *P. pedicellaris* A. St.-Hil. & Moq. and that *P. pedicellaris* is better treated as a synonym of *P. violoides* A. St.-Hil. & Moq. (as *G. violoides*). Thus, the name *P. blanchetii* (as *G. blanchetii*) is established, in keeping with its traditional treatment. Lectotypifications are provided for the following five names: *P. blanchetii*, *P. laxa* Nees & Mart., *P. maritima* Vell., *P. pedicellaris*, and *P. violoides*.

Resumo. *Polygala* seção *Gymnospora* Chodat (Polygalaceae) é reconhecida com status genérico, como *Gymnospora* (Chodat) J. F. B. Pastore, baseado nas evidências filogenéticas. Nós apresentamos duas novas combinações *G. blanchetii* (Chodat) J. F. B. Pastore e *G. violoides* (A. St.-Hil. & Moq.) J. F. B. Pastore, uma chave taxonômica para identificação das duas espécies e defendemos que *P. blanchetii* Chodat não deveria ser tratada como um sinônimo de *P. pedicellaris* A. St.-Hil. & Moq., enquanto que *P. pedicellaris* é melhor tratada como sinônimo de *P. violoides* A. St.-Hil. & Moq. (como *G. violoides*). Assim, o nome *P. blanchetii* (como *G. blanchetii*) é estabelecido, mantendo o seu tratamento mais tradicional. São também indicados lectótipos para os seguintes nomes: *P. blanchetii*, *P. laxa* Nees & Mart., *P. maritima* Vell., *P. pedicellaris* e *P. violoides*.

Key words: Brazil, *Gymnospora*, *Polygala*, Polygalaceae.

Gymnospora (Chodat) J. F. B. Pastore, here treated as a genus, was traditionally considered by Chodat (1893) and Paiva (1998), respectively, as a section or subgenus of *Polygala* L. (Polygalaceae). Currently, *Gymnospora* is comprised of two species that were included in *Polygala*, *G. violoides* (A. St.-Hil. & Moq.) J. F. B. Pastore and *G. blanchetii* (Chodat) J. F. B. Pastore. A third species originally included in *Polygala* sect. *Gymnospora* by Chodat, *P. membranacea* (Miq.) Görts, is taxonomically excluded from *Gymnospora* because it lacks the diagnostic morphological features. *Gymnospora* is endemic to Brazil, apparently restricted to forest margins and savannas. It is characterized by the following set of characters: pubescent pedicels, pubescent and free external sepals, calyx persistent in frutification, noncristate carina, puberulent and chartaceous capsules, and minute seed appendages or caruncles (Chodat, 1893; Marques, 1984). The caruncle, which is well developed in most other genera related to *Polygala*, can have a strong role in seed dispersal (Forest et al., 2007). The reduction of the caruncle and the flattened and membranous fruits suggest that *Gymnospora* is characterized by wind dispersal rather than by ants.

The generic status for *Gymnospora* is additionally supported by phylogenetic evidence (Forest et al., 2007). *Gymnospora*, represented by *G. violoides*, lies as sister to the *Badiera* DC.–*Hebecarpa* (Chodat) J. R. Abbott–*Phlebotaenia* Griseb. clade. All traditional sections or subgenera of *Polygala* are more closely related to other genera than they are to *Polygala*, e.g., *Acanthocladus* Klotzsch ex Hassk. and *Bredemeyera* Willd. Thus, using the criterion of monophyly, *Gymnospora* cannot be maintained within the genus *Polygala*. Analysis of sequence data from *G. blanchetii* has been challenging, because the extant material of the species deposited in the herbaria studied has been thus far inadequate for molecular studies (Pastore, pers. obs.). However, morphological characters shared by both species of the genus unmistakably support the similarity between species of *Gymnospora*.

After an analysis of the type collections of all relevant names, we conclude that there are two distinct species: *Polygala blanchetii* and *P. violoides*, with *P. pedicellaris* treated as a synonym of the latter. This is in agreement with the conclusions reached by Marques (1984).

I. Gymnospora (Chodat) J. F. B. Pastore, stat. nov. *Polygala* sect. *Gymnospora* Chodat, Arch. Sci. Phys. Nat. 25: 698. 1891. *Polygala* subg. *Gymnospora* (Chodat) Paiva, Fontqueria 50(4): 147. 1998. TYPE: *Polygala violoides* A. St.-Hil. & Moq.

Identification Key for *Gymnospora* Species from Southeastern Brazil

1a. Flowers 6–8 mm; bract lanceolate, 1.8–2.2 mm long; pedicel 2–6 mm long; ovary long stipitate ..... *G. blanchetii*

1b. Flowers 9–10 mm; bract deltate, 0.5–0.7 mm long; pedicel 6–8 mm long; ovary short stipitate ..... *G. violoides*

1. Gymnospora blanchetii (Chodat) J. F. B. Pastore, comb. nov. Basionym: *Polygala blanchetii* Chodat, Mém. Soc. Phys. Genève 31(2): 88. 1893. TYPE: Brazil. Bahia: Ilhéus, 1836 (fl.), *J. S. Blanchet 2385* (lectotype, designated here, P [barcode] 00733386; isolectotype, G [barcode] 00359485, G [barcode] 00359486).

Polygala laxa Nees & Mart. in Wied-Neuwied, Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12: 24. 1824, nom. illeg., non *Polygala laxa* Thunb., Prodr. Pl. Cap. 2: 121. 1800. TYPE: Brazil. Bahia: "ad flumen Ilhéos circa viam, quae est in Minas generales, in silvis primaevis," Dec. 1816 (fl.), *M. A. P. Wied-Neuwied s.n.* (lectotype, designated here, FR-s.n.; isolectotype, BR-8526069, BR-8526991).

Polygala blanchetii has been reported principally from southeastern Bahia near Ilhéus, although the taxon was collected twice from other Brazilian states (Minas Gerais and Rio de Janeiro). The species is only known from 19th century collections, and an extensive search in several regional herbaria (i.e., CEPEC, HB, HUEFS, and NY) did not uncover any more recent material. Thus, it is assumed that this species is likely extinct (Pastore, 2009). The lectotype for *Gymnospora blanchetii* was chosen from the obvious link between the original collector and species epithet, based on the citation of the herbarium on the original description, and it is also supported by Chodat's original handwriting on the sheet label. *Polygala laxa* Nees & Mart. is an illegitimate name, being a later homonym of *P. laxa* Thunb. In spite of the fact that this was the first species described in the *Gymnospora* group in 1824, no subsequent references could be found in the literature. Although the located specimens of *P. laxa* Nees & Mart. were not annotated by Nees, the specimen at FR is the only one that has been annotated with "*Polygala laxa* N. et Mart. / Dec. 1816. Prinz Max v. Neuwied leg. / Am der Minas Strasse im Urwalde," which agrees perfectly with the protologue and the information on the original label by Wied at BR [barcode] 8526069.

Additional specimens examined. BRAZIL. s. loc., 1815–1817 (fl.), *F. Sellow 1016* (BM); s. loc., s.d. (fl.), *F. Sellow s.n.* (CGE, K). **Bahia:** Ilhéus, *F. Sellow 66* (BR, K); Ilhéus, "*Prof. Ambulante*" [*sic*] *03* (R); ad Almada, "*Collector lignorum*" *03* (M [2]); in sylvis ad Almada, *C. F. P. Martius s.n.* (M). **Espírito Santo:** Rio Doce, s.d., *Anonymous s.n.* ["communic. Martius 1827," probably collected by *M. A. P. Wied-Neuwied s.n.* on Dec. 1815 or *F. Sellow s.n.* on April 1816, Moraes, pers. comm.] (BM). **Rio de Janeiro:** s. loc., 1814–1815, *Sellow L 366 B 531* (M).

2. Gymnospora violoides (A. St.-Hil. & Moq.) J. F. B. Pastore, comb. nov. Basionym: *Polygala violoides* A. St.-Hil. & Moq., Ann. Soc. Sci. Orléans 9: 55. 1828. TYPE: Brazil. Minas Gerais: "Nascitur in sylvis primaevis prope praedium Canna braba in parte orientali provinciae Minas Geraës. Florebat Aprili," s.d. (fl.), *A. Saint Hilaire 1003 Cat. B1* (lectotype, designated here, P [barcode] 00733579; isolectotypes, MPU [barcode] 012178, P [barcode] 00733580).

Polygala pedicellaris A. St.-Hil. & Moq., Mém. Mus. Hist. Nat. 17: 322. 1828. *Polygala violoides* A. St.-Hil. & Moq. var. *pedicellaris* (A. St.-Hil. & Moq.) Chodat, Mém. Soc. Phys. Genève 31, pt. 2, no. 2: 88. 1893. TYPE: Brazil. Minas Gerais: "Nascitur ad basim montis Serra da Lapa in provincià Minas Geraës. Florebat Februario," s.d. (fl.), *A. Saint Hilaire cat. B2 2177* (lectotype, designated here, P [barcode] 00733585; isolectotypes, MPU [barcode] 012177, P [barcode] 00733581, P [barcode] 00733578).

Polygala maritima Vell., Fl. Flumin.: 293. 1829. syn. nov. TYPE: Brazil. Fl. Flumin. Icon. 7: tab. 68. 1831. (lectotype, designated here, in Vellozo [1831: tab. 68]).

Polygala pachyrrhiza Casar., Nov. Stirp. Bras. Dec.: 20. 1842. TYPE: Brazil. Rio de Janeiro: "Habitat in collibus siccis circa Jurijuba et Piratininga, prope Rio de Janeiro," s.d., *G. Casaretto 1918* (holotype, GE not seen; isotype, G).

The lectotypes of *Gymnospora violoides* and *G. pedicellaris* were chosen from the distinctive label on the respective sheets, which have been associated with the original description and illustrations provided by Saint-Hilaire (1829) (see also the comments on Pastore et al., 2010). With respect to *Polygala maritima*, there are few references to Vellozo's species available in the literature. Even Marques (1979), who prepared a more recent treatment of Polygalaceae for *Flora of Rio de Janeiro*, overlooked Vellozo's names. Indeed, several reasons could be attributed for this omission. Many of Vellozo's collections have not been located (Carauta, 1973)

and may no longer be extant. His descriptions and plates (Vellozo, 1829, 1831, respectively) are often insufficient for diagnostic identification to the species level. However, *P. maritima* is one of Vellozo's species that can be unequivocally interpreted, mainly from its illustration, which presents some diagnostic characteristics such as the keel not being crested, the roots having tubercles, and all of the sepals being free. Vellozo's plate is here designated as the lectotype of *P. maritima*. Bennett (1874) misinterpreted *P. pedicellaris* and incorrectly applied the name to a specimen of what would later be described as *P. blanchetii* by Chodat (1893), even though Chodat treated *P. pedicellaris* as a variety of *P. violoides*. Bernardi (2000) evidently did not check the types either in Paris or Montpellier and followed Bennett's (1874) interpretation, treating *P. pedicellaris* as the correct name for *P. blanchetii*.

Additional specimens examined. BRAZIL. s. loc., s.d. (fl.), *F. Sellow s.n.* (BM). **Espírito Santo:** Rod. BR 101, 20 km S de Linhares, 16 Oct. 1983, *G. Hatschbach & O. Guimarães 46915* (C, CEPEC, INPA, MBM, MO, NY, RB). **Goiás:** Uruaçu, Faz. Amarra-Cachorro, 500 m abaixo da ponte sobre o Macaco, 6 Oct. 1992, *B. M. T. Walter et al. 2015* (CEN); Jataí, Faz. Matalta ca. 2 km da estrada Jataí–Caiapônia, 2 Oct. 1968, *S. F. Fônseca & E. Onishi 1010* (UB). **Mato Grosso do Sul:** Bonito, Projeto Guaicurus, ca. 4–5 km N of Bonito, 9 Nov. 2002, *G. Hatschbach et al. 74978* (HUEFS, MBM, RB, SPSF, UB). **Minas Gerais:** Guarani, UHE, de Ponte I, Palestina II, 11 Oct. 1997, *A. Salino 3549* (BHCB); Lagoa Santa, prope Rio das Velhas, *J. E. B. Warming 425* (C); Viçosa, Faz. Sobrada, rd. to Cajury, 12 Nov. 1930, *Y. E. J. Mexia 5287* (NY). **Rio de Janeiro:** near Rio Comprido, Aug. 1836, *G. Gardner 174* (BM, CGE, K); Rio de Janeiro, *C. Gaudichaud-Beaupré 696* (BM, G, K, P). **São Paulo:** São Paulo, *G. Perdonnet 14* (S).

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A New Species of *Lycoris* (Amaryllidaceae) from Hunan, China

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ABSTRACT. A new species, *Lycoris hunanensis* M. H. Quan, L. J. Ou & C. W. She (Amaryllidaceae), is described from Yuanling County in Hunan Province, China. Diagnostic morphological characters that distinguish it from the similar *L. straminea* Lindl. are presented. The clearest differences are that the perianth of *L. hunanensis* is pink in bud, lightly yellowish pink in early anthesis, and gradually fading to white later in development, with light red spots apically, while that of *L. straminea* is always ocher-yellow. *Lycoris hunanensis* has longer scapes (50–60 cm vs. ca. 35 cm long in *L. straminea*). The leaf apex of *L. hunanensis* is acuminate, which is quite different from the obtuse apex of *L. straminea*, and the leaf blade midveins are noticeably paler in *L. straminea*. The new species is assessed as Endangered (EN), according to IUCN criteria.

Key words: Amaryllidaceae, China, Hunan, IUCN Red List, *Lycoris*.

Lycoris Herb. is a small genus with ca. 20 species in the family Amaryllidaceae (Hsu & Siro, 1994) that is mainly distributed in China, Japan, and Korea and seldom occurs in Burma, Nepal, and Indonesia (Hsu & Fan, 1974; Yang, 1976). China is richest in *Lycoris* species, with 15 species and two varieties, which are mostly distributed in the Zhejiang, Jiangsu, and Anhui provinces in eastern China (Xu et al., 1985; Yuan et al., 2008). During a botanical expedition to Yuanling County in Hunan Province in August 2009, we collected an unusual plant of *Lycoris*. This 2009 collection provided insufficient material for conclusive identification, but in 2010 we collected additional material of this species in Yuanling County, and we now have quite a few living plants at the botanical garden of Huaihua University, where they have come into bloom every year since 2009. Detailed literature studies and comparisons of almost all *Lycoris* species in China at the Hangzhou Botanical Garden and the Nanjing Botanical Garden Memorial Sun Yat-Sen reveal that this species is indeed similar to *L. straminea* Lindl. but remarkably different in its flower characters and leaf shape. In fact, these characters are quite distinctive in the genus and are critical in determining its taxonomy (Fig. 1). The new species is distinguished from *L. straminea* by characters of the perianth, scape, and leaf. A taxonomic key to the *Lycoris* species from Hunan Province in China, based on the essential details of the flowers and leaf, is provided below.

Lycoris hunanensis M. H. Quan, L. J. Ou & C. W. She, sp. nov. TYPE: China. Hunan: Yuanling Co., Zhuhongxi, moist surroundings, 110°38′E, 28°43′N, 200–350 m, 7 Oct. 2009, *M. H. Quan 09007* (holotype, Huaihua University). Figure 1.

Species *Lycoridi stramineae* Lindl. similis, sed ab ea scapo 50–60 cm longo, folio ensiformi 36–39 × 1.3–1.5 cm apice acuminato atque flore per anthesin colore mutabili (primo roseo deinde pallide luteoroseo demum albo) differt.

Herbs perennial; bulbs subglobose, 3–5 cm diam., 4–6 cm, with purple-brown epidermis. Leaves 5 to 7, ensiform, 36–39 × 1.3–1.5 cm, apex acuminate, dark green; leaf midvein not distinctly paler. Scapes 50–60 cm, 10 mm diam.; involucral bracts 2, each 4–5 × 1.4–1.6 cm, lanceolate, membranous, light green, apex acuminate, direction changing in bloom. Flowers 6 to 7 per umbel, floral tube 1–1.2 cm; perianth with 6 tepals, 5–6 cm × 6–8 mm, erect in bud, later in development strongly recurved, tepal margin strongly undulate, pink in bud, lightly yellowish pink in early anthesis, later in development gradually fading to white, with scattered pink stripes adaxially and light red spots apically that gradually disappear at anthesis, and faint yellow midvein abaxially; pedicel 0.6–1 cm; stamens 6, filaments white but faintly fuchsia apically, 8–9 cm, about 1/3 longer than the perianth; anther red-brown, 6–7 × 0.8–1 mm; pistil 1, style linear, white but faint fuchsia apically; ovary hypogynous, about 5 mm, green, subspheroidal. Fruit a 3-valved capsule; seeds black, subspheroidal or hemispherical.

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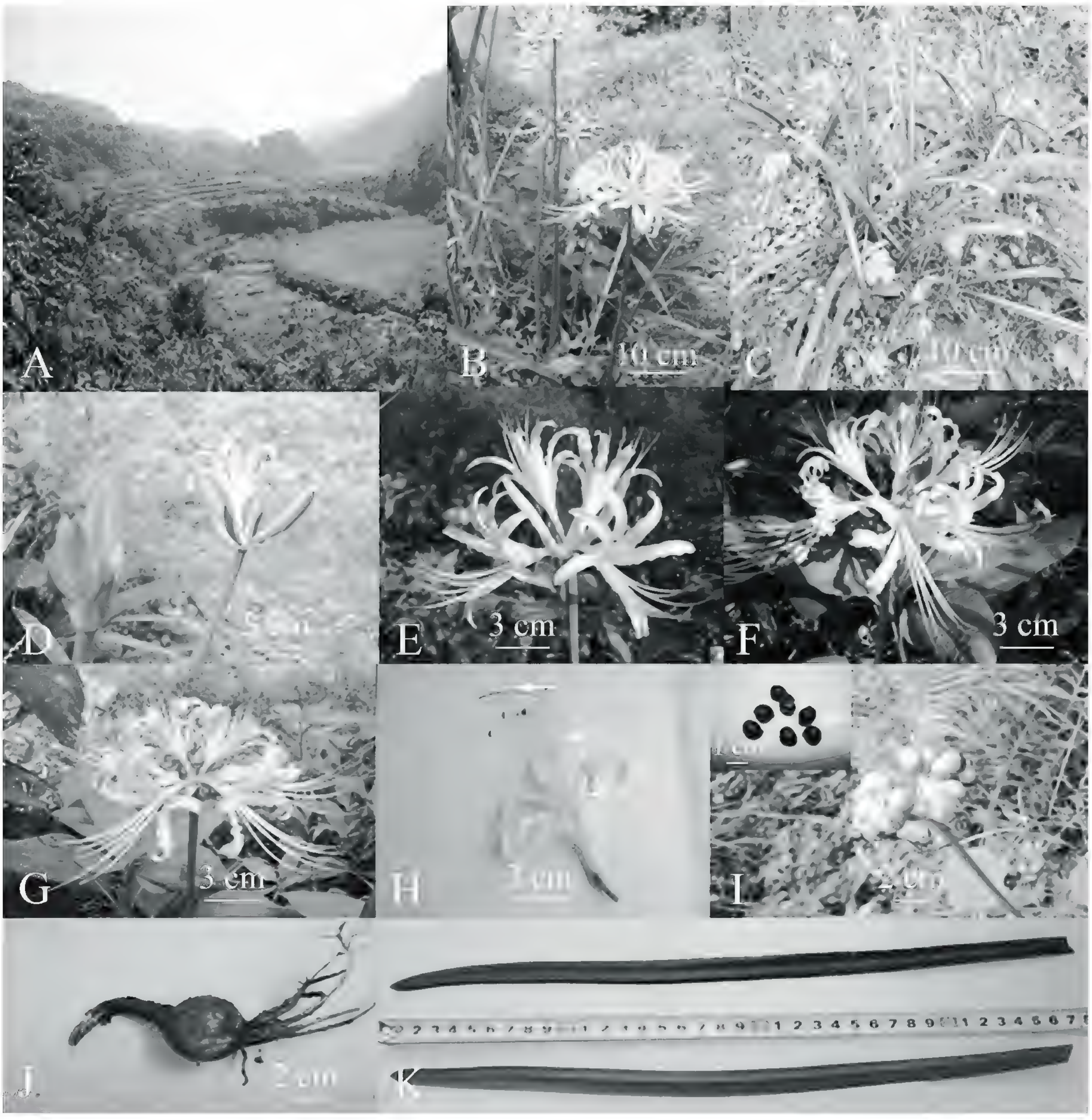

Figure 1. *Lycoris hunanensis* M. H. Quan, L. J. Ou & C. W. She. —A. Habitat at Zhuhongxi. —B. Type population, with three flowering scapes visible. —C. Vegetative habit. —D. Floral buds on umbel, with one flower beginning anthesis. —E. Flower in early anthesis. —F. Flower in mid-anthesis. —G. Flower in last stages of anthesis. —H. Flower perianth (bottom arrow), stamen (middle arrow), and pistil (top arrow). —I. Fruit (lower right) and seeds (arrow, upper left). —J. Bulb. —K. Adaxial leaf blade surface (top) and abaxial leaf blade surface (bottom). Photographs by M. H. Quan, 2010, taken in Zhuhongxi.

Distribution and habitat. *Lycoris hunanensis* occurs in Yuanling County, Hunan Province, China, growing in small riparian areas from 200 to 350 m in elevation, 110°38′–110°41′E, 28°37′–28°43′N.

IUCN Red List category. Because habitat has gradually declined for *Lycoris hunanensis* and the species is endemic to stream habitats, it should be considered Endangered (EN), according to IUCN Red List criteria (IUCN, 2001). Strict conservation measures to safeguard the known populations are urgently needed. *Lycoris hunanensis* grows in small riparian areas of Zhuhongxi in Hunan Province.

Phenology. The leaves of *Lycoris hunanensis* appear in September; flowering occurs from the end of August to September, and fruiting occurs from October to November.

Discussion. *Lycoris hunanensis* is similar to *L. straminea*, with several characters in common, including season of leaf appearance, leaf width,

recurved perianth lobes, with undulate margin, adaxial perianth with scattered pink stripes, and stamens 1/3 longer than the perianth. The two taxa differ in that the perianth color of *L. hunanensis* gradually changes in anthesis, which is pink in bud, lightly yellowish pink in early anthesis, and later in development gradually fading to white, with light red spots apically. The tepal midvein is faintly yellow abaxially in *L. hunanensis*, while that of *L. straminea* is always ocher-yellow; *L. hunanensis* has a much longer scape, from 50 to 60 cm, while that of *L. straminea* is ca. 35 cm. Finally, the leaf shape of *L. hunanensis* is ensiform, its apex is acuminate, while that of *L. straminea* is ligulate, its apex is obtuse, which remarkably differs. The midvein is distinctly paler on the green blade in *L. straminea*, a characteristic that is not seen in the entirely dark green blades of the new species.

Paratype. CHINA. **Hunan:** Yuanling Co., Zhuhongxi, 30 Aug. 2010, *M. H. Quan 201003* (Huaihua University, MO).

KEY TO THE SPECIES OF *LYCORIS* FROM CHINA (ADAPTED FROM JI & MEEROW, 2000: 266)

1a. Flowers actinomorphic; perianth lobes apically slightly recurved, margin basally minutely undulate or not undulate 2
2a. Margin of perianth lobes not undulate along entire length 3
3a. Perianth pale purple but apically blue, tube 1–1.5 cm; leaves ca. 1 cm wide ..... *L. sprengeri* Comes ex Baker
3b. Perianth white or yellow, tube 4–6 cm; leaves 1.5–2 cm wide ..... *L. longituba* Y. Xu & G. J. Fan
2b. Margin of perianth lobes basally minutely undulate 4
4a. Leaves first appearing in autumn and then reappearing in spring; perianth purple ..... *L. squamigera* Maxim.
4b. Leaves appearing in spring; perianth yellow or white 5
5a. Perianth always yellow, tube 2.5–3.5 cm; leaves ca. 2 cm wide ..... *L. anhuiensis* Y. Xu & G. J. Fan
5b. Perianth white, later in development gradually changing to yellowish pink, tube ca. 1 cm; leaves ca. 1.2 cm wide ..... *L. incarnata* Comes ex Sprenger
1b. Flowers zygomorphic; perianth lobes recurved, margin everywhere undulate 6
6a. Leaves appearing in autumn; stamens obviously longer than perianth 7
7a. Stamens 1/6 longer than perianth, perianth yellow or light rose-red 8
8a. Perianth yellow; leaves ensiform, ca. 60 × 2 cm, apex acuminate ..... *L. aurea* (L'Hér.) Herb.
8b. Perianth light rose-red; leaves ligulate, ca. 20 × 1 cm, apex rounded ..... *L. rosea* Traub & Moldenke
7b. Stamens 1/3 longer to twice the length of the perianth, perianth bright red, white, ocher-yellow, or discolored 9
9a. Stamens twice the length of the perianth, perianth bright red; leaves narrowly ligulate, ca. 0.5 cm wide ..... *L. radiata* (L'Hér.) Herb.
9b. Stamens 1/3 longer than perianth, perianth white, ocher-yellow, or discolored; leaves ligulate or ensiform, 1.2–1.5 cm wide 10
10a. Perianth pink in bud, becoming lightly yellowish pink in early anthesis, then gradually fading to white, adaxially with scattered pink stripes, abaxially with faint yellow midvein; leaves ensiform, dark green, 36–39 × 1.3–1.5 cm, apex acuminate ..... *L. hunanensis*
10b. Perianth white or ocher-yellow, adaxially with or without scattered pink stripes, abaxially with green midvein; leaves ligulate, green or dark green, ca. 30 × 1.2–1.5 cm, apex obtuse 11
11a. Perianth ocher-yellow, adaxially with scattered pink stripes; leaves green, ca. 1.5 cm wide ..... *L. straminea*
11b. Perianth white, adaxially without scattered pink stripes; leaves dark green, ca. 1.2 cm wide ..... *L. houdyshelii* Traub
6b. Leaves appearing in spring; stamens shorter to slightly longer than perianth 12
12a. Stamens shorter than perianth; leaf midvein not distinctly pale 13
13a. Perianth pink in bud, becoming creamy at anthesis, then gradually fading to white, lobes without pink stripes ..... *L. caldwellii* Traub
13b. Perianth white with red stripes in bud, fading to white at anthesis, lobes adaxially with scattered pink stripes ..... *L. shaanxiensis* Y. Hsu & Z. B. Hu
12b. Stamens nearly as long as to slightly longer than perianth; leaf midvein distinctly pale (except in *L. albiflora* Koidz.) 14
14a. Perianth pink in bud, becoming creamy as buds develop, then gradually fading to white, lobes adaxially with scattered pink stripes, abaxially with pink midvein ..... *L. albiflora*
14b. Perianth yellow, lobes adaxially with or without stripes or spots 15
15a. Perianth lobes adaxially without red stripes; leaves green, ligulate, ca. 35 × 2 cm ..... *L. chinensis* Traub
15b. Perianth lobes adaxially with red stripes or brushlike spots; leaves dark green, narrowly ligulate, 24–29 × 1–1.2 cm ..... *L. guangxiensis* Y. Xu & G. J. Fan

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Holcus pintodasilvae (Poaceae, Pooideae, Poeae), a New Species from the Island of Madeira (Portugal), and Notes on Macaronesian *Holcus*

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ABSTRACT. A new species of *Holcus* L. (Poaceae), endemic to the island of Madeira (Portugal), is here described as *H. pintodasilvae* M. Seq. & Castrov. This new species is morphologically closely related to the Macaronesian endemics *H. rigidus* Hochst. ex Hochst. (Azores Archipelago) and *H. mollis* L. subsp. *hierrensis* Stierst. (El Hierro Island, in the Canary Islands) but differs by having the culm nodes light brown, the leaves with a glabrous sheath and subspreading lamina attenuated to an acuminate apex, the glumes blunt, shiny, glabrous (except in the minutely scabrous veins), the upper glume with proximal lateral veins, and the lemma of the upper floret with an awn ca. 4 mm, twice as long as the lemma. Chromosome counts in *H. pintodasilvae* are tetraploid ($2n = 28$). Morphology, ecology, biogeography, and conservation issues are discussed and related to other Macaronesian *Holcus* taxa. *Holcus pintodasilvae* was found as only three populations (totaling less than 20 individuals), and its IUCN conservation status is Critically Endangered (CR). A new specific status is proposed for *H. mollis* subsp. *hierrensis*, as *H. hierrensis* (Stierst.) Stierst. & M. Seq., based on its chromosome number and morphological identity.

RESUMO. Descreve-se uma nova espécie, *Holcus pintodasilvae* M. Seq. & Castrov., pertencente ao género *Holcus* L. (Poaceae), endémica da Ilha da Madeira (Portugal). Morfologicamente próxima dos endemismos macaronésicos *H. rigidus* Hochst. ex Hochst. (Arquipélago dos Açores) e *H. mollis* L. subsp. *hierrensis* Stierst. (Ilha de Hierro, Arquipélago das Canárias) diferencia-se por possuir: nós de coloração castanha-clara; folhas com bainhas glabras e lâminas subpatentes atenuadas num ápice acuminado; glumas brilhantes, múticas e glabras (excepto nas nervuras que se apresentam escabriúsculas), gluma superior com as nervuras laterais proximais; lema da flor superior com arista ca. 4 mm (duas vezes o comprimento da lema). Incluem-se ainda resultados da contagem de cromossomas de *H. pintosilvae* ($2n = 28$). Discutem-se, e relacionam-se com outros taxa Macaronésicos do género *Holcus*, aspectos relativos à morfologia, ecologia, biogeografia e conservação. *Holcus pintodasilvae* foi encontrado em apenas três populações (num total de menos de 20 indivíduos), sendo o seu estado de conservação IUCN está criticamente ameaçado (CR). Propõe-se ainda a combinação *H. hierrensis* (Stierst.) Stierst. & M. Seq. baseada na sua identidade morfológica e número cromossomático.

Key words: Gramineae, *Holcus*, IUCN Red List, Macaronesia, Madeira, Poaceae, Portugal.

In a recent revision of the genus *Holcus* L. (Menezes de Sequeira, 2004), nine species, five subspecies, one \hybrid, and one variety were recognized. More recently, *H. azoricus* M. Seq. & Castrov. was described as an Azores endemic of possible hybrid origin (Menezes de Sequeira & Castroviejo, 2007). The genus *Holcus* is restricted to the Old World, but the human-mediated expansion of *H. lanatus* L. and *H. mollis* L. subsp. *mollis* give *Holcus* a worldwide distribution (Menezes de Sequeira, 2004; Menezes de Sequeira & Castroviejo, 2006). Within the genus, five taxa are Iberian Peninsula endemics (*H. grandiflorus* Boiss. & Reut., *H. gayanus* Boiss., *H. caespitosus* Boiss., *H. reuteri* Boiss., and *H. annuus* C. A. Mey. subsp. *duriensis* (P. Silva) Franco & Rocha Afonso), one taxon is a South African Cape Province endemic (*H. annuus* subsp. *setiger* (Nees) M. Seq. & Castrov.), and three are Macaronesian endemics (*H. rigidus* Hochst. ex Hochst., *H. mollis* subsp. *hierrensis* Stierst., and *H. azoricus*). Recent molecular data seem to group *Holcus* within the subtribe Holcinae of Poeae, possibly with the genus *Vahlodea* Fr. (Soreng et al., 2003; Quintanar et al., 2007), rather than sharing a common ancestor within Aveneae (e.g., *Deschampsia* P. Beauv. and *Hierochloe* R. Br.), as previously

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suggested by Clayton and Renvoize (1986) and Watson and Dallwitz (1994).

The Madeira Archipelago is composed of two main islands, Porto Santo (dating back to ca. 20 Ma) and Madeira (less than 5.6 Ma; Ribeiro et al., 2005). The island of Madeira is situated between 32°38′ and 32°52′N and 16°39′ and 17°16′W, approximately 600 km northwest of the western African coast, with a land area of 737 km². The vascular flora of Madeira includes 1137 taxa (species and subspecies), of which 96 taxa are exclusive endemics, with the Poaceae being the most diverse plant family (133 taxa, with six endemics, including *Agrostis obtusissima* Hack., *Anthoxanthum maderense* Teppner, *Deschampsia argentea* (Lowe) Lowe, *D. maderensis* (Hack. & Bornm.) Buschm., *Festuca donax* Lowe, and *Koeleria loweana* Quintanar, Catalán & Castrov.; see Jardim & Menezes de Sequeira, 2008).

Hansen and Sunding (1979, 1993) and Cope (1994) listed *Holcus lanatus* for the islands of Madeira, Porto Santo, and the Selvagens and *H. mollis* for Madeira. Other authors, such as Menezes (1906, 1914), mention only *H. lanatus*. In fact, *H. lanatus* collections date back to the 19th century, and the species' expansion is clearly human-mediated through habitat change, but its arrival in the flora could have been prior to human settlement (Menezes de Sequeira, 2004; Jardim & Menezes de Sequeira, 2008), at least on marine cliffs and in humid habitats. Although Cope (1994) regarded *H. mollis* as native, and Robert Brown (1773–1858) listed the plant in his account of Madeiran species (Britten, 1904) (possibly in error for *H. lanatus*, not included on the list), and recently Vieira (2002), based on Cope (1994), excluded this species in his account of the exotic plants of Madeira, references to *H. mollis* are very recent. The first known specimen of *H. mollis* was collected by Costa with the notes "Santa, no Pôrto do Moniz, vii–1934, Costa, MADM," possibly corresponding to a human-mediated introduction, established during the massive afforestation that took place in the first half of the 20th century (Menezes de Sequeira et al., 2007; Jardim & Menezes de Sequeira, 2008).

The Macaronesian endemics *Holcus rigidus* and *H. mollis* subsp. *hierrensis* (Stierstorfer, 2001; Menezes de Sequeira & Castroviejo, 2007) are small chamaephytes with aboveground branching, whereas *H. azoricus* is a rhizomatous hemicryptophyte of putative hybrid origin (*H. rigidus* × *H. lanatus;* Menezes de Sequeira & Castroviejo, 2007). The morphological segregation of Macaronesian endemics belonging to the genus *Holcus*, namely the chamaephyte habit, clearly suggests that a specific rank should be applied to these endemics, and accordingly, a new status is proposed for *H. mollis* subsp. *hierrensis*.

1. Holcus hierrensis (Stierst.) Stierst. & M. Seq., comb. et stat. nov. Basionym: *Holcus mollis* L. subsp. *hierrensis* Stierst., Feddes Repert. 112: 49. 2001. TYPE: Spain. Canary Islands: El Hierro, SE of Eremita de la Caridad, 1270 m.s.m., UTM 28RBR065742, N-facing slope, Vitrands, blocks of lava, 10 July 1999, *Ch. Stierstorfer s.n.* (holotype, B-100006407; isotypes, M not seen, TFC not seen).

Apart from the new status proposed above as *Holcus hierrensis* for the El Hierro endemic, recent fieldwork demonstrated the presence of a new species restricted to Madeira. Plants of this new species found in the higher mountains of Madeira show a typical Macaronesian chamaephyte habit, but they also show very distinct characters, and accordingly a new species is described herein.

2. Holcus pintodasilvae M. Seq. & Castrov., sp. nov. TYPE: Portugal. Madeira: Pico do Arieiro, ca. Pico do Gato, 1670 m.s.m., exp. N, 32°44′30.6″N, 16°56′17.4″, 16 July 2003, *M. Menezes de Sequeira 4368* (holotype, MA-807339). Figures 1–4.

Haec species inter congeneros chamaephyta rhizomatosa *Holco rigido* Hochst. ex Seub. et *H. hierrensi* (Stierst.) Stierst. & M. Seq. similis, sed ab eis nodis brevissimis atque dilute castaneis, foliorum vaginis laminisque glabrescentibus laminis subpatentibus atque attenuato-acuminatis, glumis nitentibus fere glabris (praeter nervos carinamque minute scabros), gluma superiore nervis lateralibus propius ad costam quam marginem et flosculi superioris lemmate in aristam ca. 4 mm longam (lemmate duplo longiorem) desinente differt.

Rhizomatous chamaephyte (Figs. 1A, 3B), with a slender ramified rhizome; culms 55–79 cm tall, branched above ground; nodes light brown, 0.5–1 mm, glabrous (Figs. 1B, 3C). Leaves rigid, subpungent, subspreading; sheath glabrous (Fig. 1B), median leaves with sheath 3.8–6.6 cm, upper leaves with sheath 7–11 cm; lamina minutely scabrous (Fig. 2A, B), linear-lanceolate (Fig. 3A), flat to convolute, persistent, attenuate to an acuminate apex, median leaves 57.7–104.2 × 2.6–5.1 mm, upper leaves 11.8–35.7 × 8.4–15.3 mm; ligule 2–2.8 mm (Figs. 1B, 3D), asymmetric with long asymmetrical teeth, membranous, glabrous except for the short ciliate margins (hairs 14–26 μm), shortly toothed. Panicle (Figs. 3A, 4) 4.7–7.7 cm, whitish and shiny (Fig. 1C), few-flowered (ca. 100), somewhat compact (spike-like), regular in outline; branches scabrous with

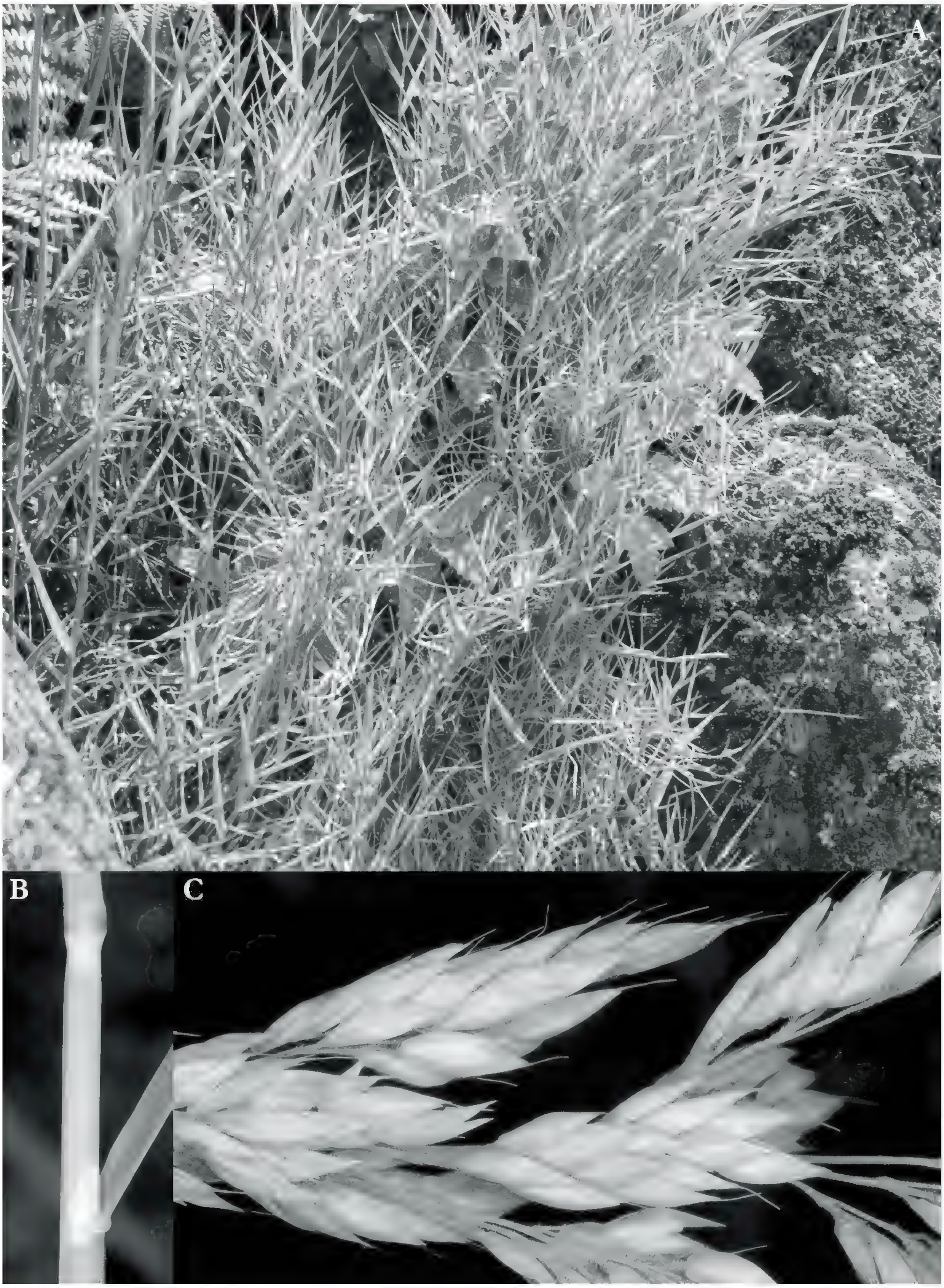

Figure 1. *Holcus pintosasilvae* M. Seq. & Castrov. —A. Habit. —B. Detail of the node, stem, and ligule. —C. Detail of the inflorescence. Photographs taken in Madeira in Bica da Cana by M. Sequeira on 26 June 2007.

acicular hairs. Spikelets (Figs. 1C, 3E, 3F) 4.5–6.4 mm, falling entire, with a well-marked abscission zone at the base of the glumes, with 2 florets; glumes thinly papery, shiny, slightly unequal, enclosing the flowers, apex acuminate, blunt, keeled, both keel and nerves minutely scabrous; lower glume 4.5–5.8 × 1.7–2.1 mm, 1-nerved (Fig. 3G), lamina glabrous, shiny, keel scaberulous, prickle hairs 19–109 μm,

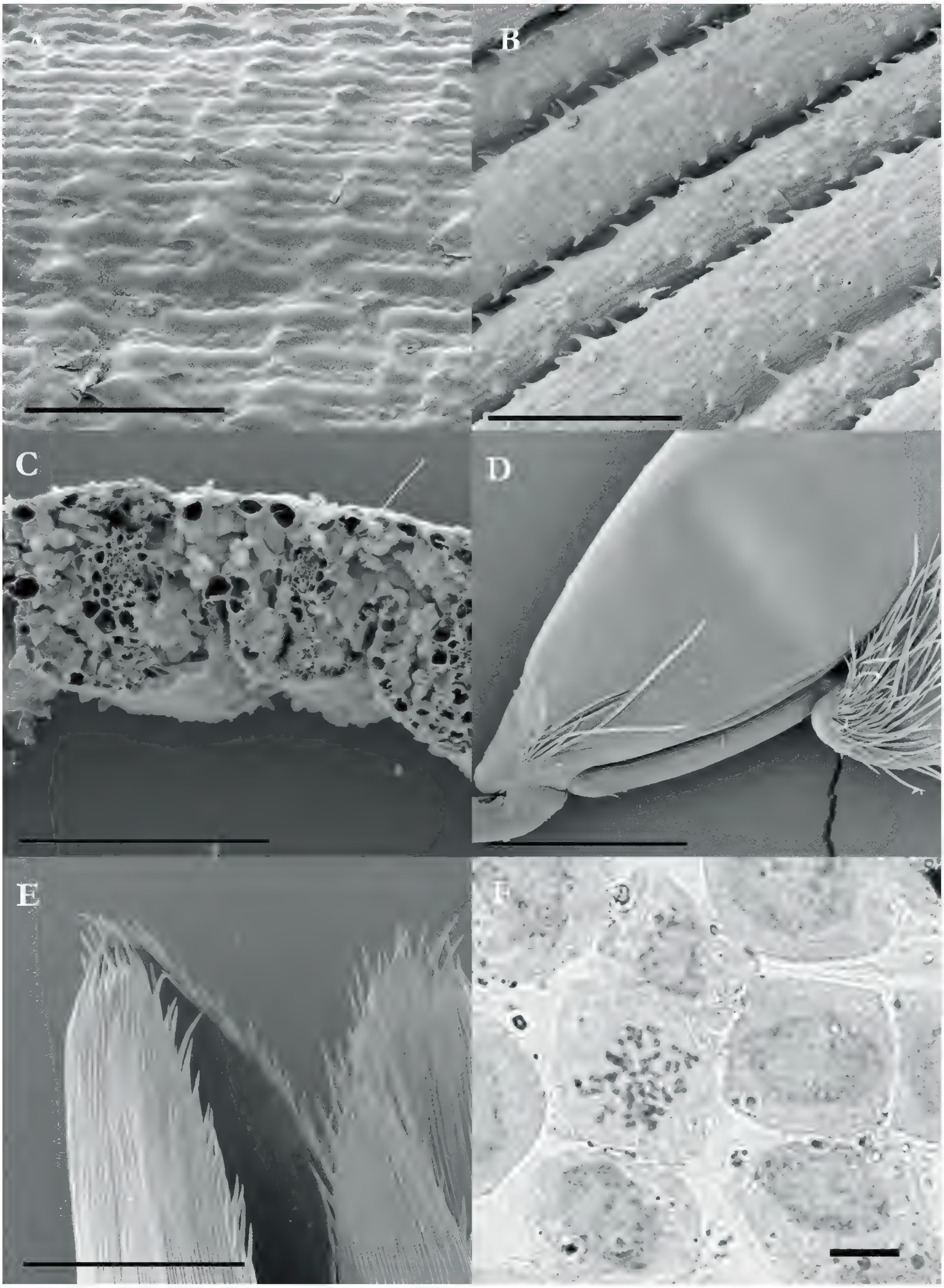

Figure 2. Scanning electron micrographs (taken on a JEOL-TSM T330A) of *Holcus pintodasilvae* M. Seq. & Castrov. (*M. Menezes de Sequeira 4368*, holotype, MA 807339). —A, B. Leaf adaxial surfaces. —C. Leaf section showing sclerenchyma cells (arrow). —D. Median rachis and florets, with callus showing indumentum. —E. Lower floret, showing lemma and palea apex (taken from the paratype *M. Sequeira 4630B*, MADM). —F. Cells in somatic metaphase, $2n = 28$, prepared from rhizomes cultivated at MADM. Scale bars: A = 100 μm; B, E = 300 μm; C = 200 μm; D = 500 μm; F = 10 μm.

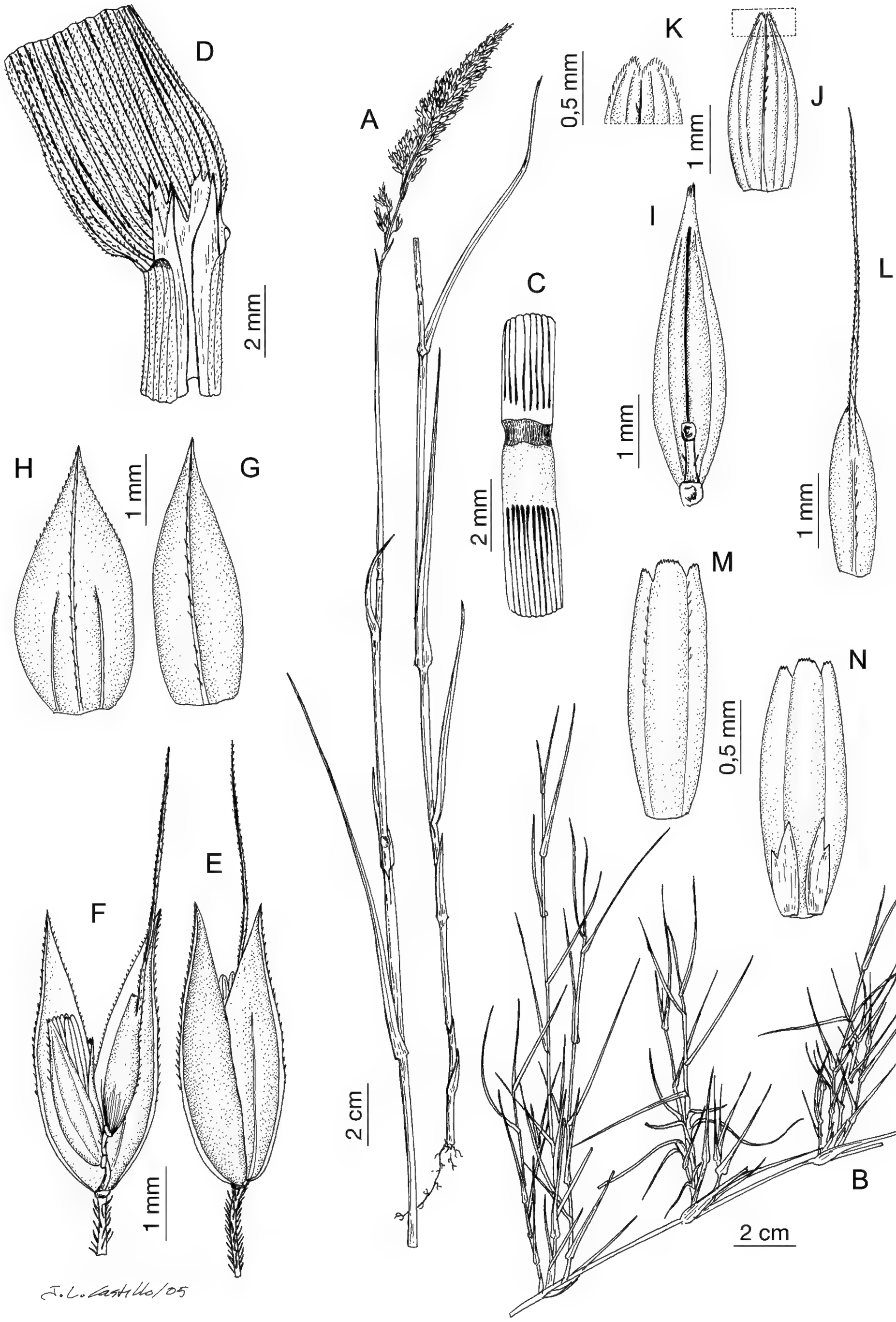

Figure 3. *Holcus pintodasilvae* M. Seq. & Castrov. —A. Culm and panicle. —B. Branching habit. —C. Culm node. —D. Detail of ligule at sheath and blade junction. —E. Spikelet. —F. Longitudinal section of the spikelet. —G. Lower glume. —H. Upper glume. —I. Lower floret. —J. Lemma of the lower floret. —K. Apex of the lower lemma. —L. Upper lemma. —M. Palea of lower floret (dorsal view). —N. Palea of lower floret (ventral view) and lodicules. Drawn from the holotype *M. Menezes de Sequeira 4368* (MA-807339).

Figure 4. *Holcus pintodasilvae* M. Seq. & Castrov. Photograph of the holotype *M. Menezes de Sequeira 4368* (MA-807339).

apex acuminate, blunt; upper glume 4.4–6.1 × 2.3–3 mm, 3-nerved (Fig. 3H), lateral veins proximal, keel scaberulous, prickle hairs 23–82 μm, apex acuminate blunt; rachilla disarticulating, extending beyond the distal floret, divided in 3 parts: proximal segment short, 0.33–0.53 mm (between the glumes and the first floret), curved, glabrous; the median segment (between the florets) longer, 0.6–0.75 mm, straight, glabrous to puberulous (Figs. 2D, 3F); distal segment (above the upper floret), rudimentary, ca. 0.1 mm,

villous and setose. Lower floret hermaphroditic; callus very short, glabrous; lemma cartilaginous (Fig. 3J), 2.2–2.6 mm, shortly puberulous on the keel, deeply emarginate, short ciliate (Figs. 2E, 3K); palea 2.1–2.5 mm, membranous, trilobed with the lateral lobes as long as or slightly shorter than the median (entire) (Figs. 2E, 3M, 3N), keels (2) pubescent, included within the lemma, adherent to the caryopsis, lodicules ca. 0.7 mm (Fig. 3N), with a turgescent circular-elliptic base, glabrous, acuminate, symmetric, with a short lateral tooth, ca. 35 μm, inserted in the distal 2/3; stamens 3 (falling before those of the upper floret), anthers ca. 1.2–1.3 mm long, blunt. Upper floret staminate; callus 0.1–0.2 mm long, pear-shaped to rounded, pubescent with hairs 36–915 μm long; lemma 2.2–2.6 mm (Fig. 3L), puberulous, emarginate, with a dorsal awn 3.3–4.1 mm, geniculate, inserted in the distal 2/3 to 3/4 of the lemma; palea 2–2.4 mm, 2-nerved, shortly trilobed, pubescent; anthers ca. 1.3 mm long, blunt.

Leaf anatomy. Although Watson and Dallwitz (1994) indicated that all sclerenchyma cells in *Holcus* are associated with vascular bundles, the presence of sclerenchyma cells close to the abaxial blade surface not associated with the vascular bundles was indicated by Menezes de Sequeira (2004) exclusively for *H. rigidus*. However, *H. pintodasilvae* also presents sclerenchyma cells beneath the abaxial surface that are not associated with the vascular bundles (Fig. 2C). Leaf rigidity results from the presence of these sclerenchyma cells not associated with the vascular bundles and also from the presence of sclerenchyma in all the vascular bundles.

Chromosome counts. Due to the scarcity of individuals found in nature, chromosome counts, in accordance with Menezes de Sequeira and Castroviejo (2007), were performed in only three rhizome portions collected (non-destructive sampling) from three different plants that were then grown at the University of Madeira gardens. Chromosome counts on *Holcus pintodasilvae* correspond to a tetraploid genome, with $2n = 28$ (Fig. 2F). Due to chromosome pairing, an autopolyploid origin is hypothesized, possibly close to *H. mollis*.

Polyploidy is common among endemic Macaronesian grasses, for example, the tetraploid Madeiran *Dactylis smithii* Link subsp. *hylodes* P. F. Parker (Parker, 1972) and the high 25-ploid Madeiran *Koeleria loweana* (Quintanar et al., 2006). However, Menezes de Sequeira et al. (2009) have shown that this is not the case for native *Festuca* L., where all five Macaronesian species were diploid. *Holcus pintosasilvae* is a tetraploid taxon, as are *H. rigidus* (Menezes de Sequeira, 2004; Menezes de Sequeira & Castroviejo, 2007) and *H. hierrensis* (Strierstorfer, 2001). These Macaronesian endemic and tetraploid *Holcus* species correspond to apoendemics, following the classification proposed by Favarger and Contandriopoulos (1961) and Contandriopoulos (1988). They are presumed to have evolved from one or several colonization events from *H. mollis* diploid paleoendemic-patroendemic (see Favarger & Contandriopoulos, 1961; Contandriopoulos, 1988) Iberian populations, as suggested by Menezes de Sequeira (2004) and Menezes de Sequeira and Castroviejo (2007). This was in agreement with Boissier and Reuter (1852), who considered Hispania (the Iberian Peninsula) and part of Mauritania (northwestern Africa) to be the dispersal center for the genus *Holcus*. References to diploid *H. mollis* plants, in fact, are restricted to Portugal (Fernandes & Queirós, 1969) and Bulgaria (Walter, 1980), possibly corresponding to a formerly continuous Ibero–Turanian distribution affected by Pleistocene glaciations (Menezes de Sequeira, 2004).

Distribution and habitat. *Holcus pintodasilvae* is a very rare endemic found so far in only three populations on Madeira. As has been stated by Menezes de Sequeira et al. (2008) for the recently described *Teucrium francoi* M. Seq., Capelo, J. C. Costa & R. Jardim, there was a positive impact on population numbers and size caused by the removal of goats from the higher mountains of Madeira (Sousa, 2003), and this was possibly related to the discovery of *H. pintodasilvae*. However, the new taxon could have been overlooked by previous collectors, who could have confused it with *Anthoxanthum maderense* or *Agrostis obtusissima,* which have a similar growth form. The chamaephytic habit is strongly correlated with susceptibility to damage from grazing, and the rarity of *H. pintodasilvae* could therefore be related to the long-term effects of grazing by goats introduced immediately after human colonization in the 15th century, which caused massive landscape changes (Menezes de Sequeira et al., 2007). Although Silva et al. (unpublished) noted a quick recovery of the formerly rare plant endemics after goats were removed, they also observed that this recovery was followed by a strong resurgence of invasive plants such as *Cytisus scoparius* (L.) Link subsp. *scoparius*, with negative impacts on chamaephytic endemics, such as *H. pintodasilvae,* by habitat reduction. *Holcus pintodasilvae* occurs in the *Armerio maderensis–Parafestucetum albidae* and *Teucrio francoi–Origanetum virentis* plant communities (Capelo et al., 1999; Costa et al., 2004).

Table 1. Diagnostic characters of *Holcus pintodasilvae* M. Seq. & Castrov. and related taxa.

Characters	*H. azoricus*	*H. rigidus*	*H. mollis*	*H. hierrensis*	*H. reuteri*	*H. pintodasilvae*
Life form	rhizomatous hemicryptophyte, with a short slender rhizome	rhizomatous chamaephyte, with a long slender rhizome	rhizomatous hemicryptophyte, with a long slender rhizome	rhizomatous chamaephyte, with a long slender rhizome	rhizomatous hemicryptophyte, with enlarged rhizome	rhizomatous chamaephyte, with a long slender rhizome
Nodes	dark, pubescent	dark, glabrous	sometimes dark, bearded	sometimes dark, bearded	sometimes dark, bearded	light brown, glabrous
Leaves	not spreading, subpungent; sheath pubescent to villose	spreading, pungent; sheath glabrous	not spreading or pungent; sheath pubescent to villose	not spreading or pungent; pubescent toward the base	not spreading or pungent; sheath glabrous, rarely pubescent toward the base	subspreading, subpungent; sheath glabrous
Ligules	symmetric, surface puberulous to pubescent	asymmetric, surface glabrous to puberulous	symmetric, surface glabrous to puberulous	symmetric, surface puberulous	symmetric, surface pubescent (rarely glabrous)	asymmetric, surface glabrous
Leaf blades	scaberulous to pubescent, linear-lanceolate, attenuate in subacuminate apex	scaberulous, linear-lanceolate, attenuate in acuminate and rigid apex	pubescent, linear to oblong-lanceolate, attenuate in acute apex	pubescent, linear to oblong-lanceolate, attenuate in acute apex	pubescent, linear to oblong-lanceolate, attenuate in acute apex	scaberulous, linear-lanceolate, attenuate to acuminate apex
Glumes	equivalent, usually mucronate	slightly different, seldom mucronate	slightly different to unequal, blunt	slightly different, blunt	slightly different to unequal, blunt	slightly different, blunt
Upper glume of florets	lateral veins usually proximal	lateral veins usually marginal	lateral veins proximal	lateral veins marginal	lateral veins proximal	lateral veins proximal
Glume indumentum	keel, veins, and lamina minutely scabrous to pubescent	keel, veins, and lamina minutely scabrous	keel and veins with long hairs; lamina minutely scabrous to pubescent	keel and veins with long hairs; lamina minutely scabrous to pubescent	keel and veins with long hairs; lamina minutely scabrous to pubescent	keel and veins minutely scabrous; lamina glabrous, shiny
Inferior palea of florets	1.7–2.5 mm, trilobed, lateral lobes shorter than the median	2.1–2.4 mm, trilobed, lateral lobes much shorter than the median (emarginate)	1.7–2.6 mm, trilobed, lateral lobes much shorter than the median	1.9–2.1 mm, trilobed, lateral lobes slightly shorter than the median	2–2.4 mm, trilobed, lateral lobes shorter than the median	2.1–2.5 mm, trilobed, lateral lobes as long as or slightly shorter than the median (entire)
Median segment of rachilla	glabrous to pubescent	puberulous to pubescent	puberulous to villose and setose	villose and setose	puberulous to pubescent	glabrous to puberulous
Lema of upper distal staminate floret	1.9–2.6 mm	2.4–2.9 mm	1.9–3 mm	1.9–2.5 mm	2.3–2.7 mm	2.2–2.6 mm
Awn of the upper staminate floret	1.9–3.9 mm, hooked or geniculate	2.2–3.9, geniculate	0.2–5.5 mm, geniculate	3.1–3.7 mm, geniculate	4.3–5.2 mm, geniculate	3.3–4.1 mm, geniculate

IUCN Red List category. *Holcus pintodasilvae* should be considered as Critically Endangered (CR, C2a(i,ii)D; IUCN, 2001) since only three populations are known (less than 20 individuals). These populations occupy an area of less than 200 m^2 and appear to have been reduced in size by past grazing (the plant habit and the fact that they were discovered after grazers were removed seem to support this hypothesis).

Phenology. Flowering in *Holcus pintodasilvae* occurs from May to July.

Etymology. The new species epithet is dedicated to António Rodrigo Pinto da Silva (1912–1992), a respected Portuguese botanist who also studied the flora of Madeira and contributed to the foundation of the Madeira Botanical Garden.

Discussion. Several examples of perennial chamaephyte grasses occur on Madeira. The most spectacular is *Koeleria loweana* [≡ *Parafestuca albida* (Lowe) E. B. Alexeev]. *Dactylis smithii* and *Anthoxanthum maderense* also display the perennial chamaephyte habit that characterizes *Holcus pintodasilvae*. *Holcus pintodasilvae* shares a similar morphology with the *H. mollis* species complex (*H. mollis*, *H. reuteri*, *H. hierrensis*, *H. rigidus*, and also partially with *H. azoricus*). These characteristics include the rhizomatous, perennial habit (Figs. 1A, 3B, 4), deciduous spikelets, blunt glumes, two florets, with the lower floret hermaphroditic and awnless but the upper floret staminate with a long geniculate awn. Study of fertile specimens of the new species indicates an overall resemblance with both *H. rigidus* and *H. hierrensis*. However, other characteristics clearly separate *H. pintodasilvae* from morphologically closely related species (cf. Table 1). *Holcus pintodasilvae* and *H. rigidus* have rigid stems and leaves, but *H. pintodasilvae* differs from other taxa by its short and congested branching of the culm, the glabrous, light brown, and very short nodes (Fig. 1B), the less-pointed leaves (not so clearly spreading), the glabrescent sheaths and lamina (only extremely short, scabrous prickle hairs are present), and the strongly asymmetric ligules. Unlike *H. rigidus* and *H. hierrensis*, *H. pintodasilvae* presents proximal nerves in the upper glume, and it differs from all other species in the *H. mollis* complex by presenting shiny glumes.

Paratypes. PORTUGAL. **Madeira:** Bica da Cana, 1500 m.s.m., 90°E, 26 June 2005, *M. Menezes de Sequeira 4625B* (MADM); Circa Pico do Areeiro, Manga dos Vómitos, 1650 m.s.m., NNW, 26 June 2005, *M. Menezes de Sequeira 4630B* (MADM; MO); Bica da Cana, nas fissuras terrícolas do afloramento rochoso perto do posto florestal, 5 Aug. 2004, *M. Menezes de Sequeira & P. Catálan 4538* (MADM); Achada do Teixeira, subida para o Pico Ruivo, 1703 m.s.m., exp. N, 32°45.8′N, 16°55.9′W, 18 July 2010, *M. Menezes de Sequeira & R. Piñeiro 6687* (MADM).

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Amomum sahyadricum (Zingiberaceae), a New Species from the Western Ghats, India

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Abstract. The new species *Amomum sahyadricum* V. P. Thomas & M. Sabu (Zingiberaceae) is described and illustrated from the Western Ghats, India. The new species is related to *A. muricatum* Bedd., but differs from it in the smaller habit (33–60 cm vs. 70–150 cm in *A. muricatum*), the prominently raised veins on the adaxial surface of the leaf lamina (vs. immersed venation), the fleshy and thick bracts (vs. membranous bracts), 2-horned bracteoles, the calyx with three mucronate teeth, dorsal corolla lobe mucronate at apex, and the rugose to muricate fruits (vs. echinate fruits). IUCN status, distribution, phenology, and ecological details are provided.

Key words: *Amomum*, India, IUCN Red List, Western Ghats, Zingiberaceae.

Amomum Roxb. (Zingiberaceae) is the second largest genus in the ginger family after *Alpinia* Roxb. *Amomum* comprises ca. 150 to 180 species and is widely distributed in Southeast Asia (Xia et al., 2004). In India, *Amomum* is mainly distributed in the northeast, but also is found from peninsular India and the Andaman and Nicobar Islands. Sabu (2006) recorded six species of *Amomum* from South India. Thomas et al. (2009) reported the occurrence of *A. fulviceps* Thwaites from Western Ghats. Thomas et al. (2012) and Thomas and Sabu (2012) described an additional three species from Western Ghats, viz. *A. nilgiricum* V. P. Thomas & M. Sabu, *A. agastyamalayanum* V. P. Thomas & M. Sabu, and *A. newmanii* M. Sabu & V. P. Thomas, which raises to 10 the number of species reported for peninsular India. During the collection of Zingiberaceae from Agastyamala in the Western Ghats, Kerala, India, we encountered an interesting specimen of *Amomum*, distinct from any known described species. On critical study, we determined this to be a new species, and it is herein described and illustrated.

Amomum sahyadricum V. P. Thomas & M. Sabu, sp. nov. TYPE: India. Kerala: Thiruvananthapuram, Agastyamala, Athirumala, 8°37′3.8″N, 77°13′47″E, 1014 m, 1 Mar. 2008, *V. P. Thomas & A. V. Prasanth 103034* (holotype, CALI; isotype, MH). Figure 1.

Amomo muricato Bedd. similis, habitu minore, foliis adaxialiter venis prominente elevatis, bracteis carneis crassis, bracteolis bicornutis, calyce cum tres dentis mucronatis, corollae lobo dorsali mucronatis, fructibus rugosisve muricatis differt.

Rhizome slender, stoloniferous, creeping, 3–7 mm thick, length:breadth ratio ca. 30:1, sheathed with scales; scales chartaceous, 2–2.5 cm, margin distantly ciliate, apex rounded, a cusp (ca. 1 mm) just behind the apex, puberulous externally; leafy shoots 33–60 cm, leafless shoots 18–30 cm long. Leaf sheaths 1.1–1.4 cm wide at base, green, margin sparsely ciliate, apex slightly emarginate with a cusp just behind apex, puberulous externally; leaves 6 or 7 per leafy shoot; laminae elliptic to elliptic-lanceolate, 12–26 × 2.9–5 cm, base cuneate, margin slightly wavy, apex acuminate, glabrous on both surfaces; venation prominently raised adaxially; petiole 4–7 mm, green, glabrous; ligule entire, 3–5 mm, coriaceous, glabrous with margin ciliate, apex rounded. Inflorescence radical, arising from the rhizome, 12–19 cm, 1 or 2 open at a time; peduncle 9–13 cm; bracts ovate to oblong, 2.5–3.5 × 1.5–1.7 cm, thick and fleshy, pink-red, margin ciliate, apex acute, pubescent externally, glabrous internally; bracteole tubular, 2-lobed, 1.9–2.2 cm × 5–6 mm, 2-horned, these resembling deer horns, membranous, pale pink, pubescent outside, glabrous inside. Flowers 4.2–5 cm, yellow; calyx tubular, 2.4–2.6 cm × 5–6 mm, pale pink, apex with 3 mucronate teeth, slightly curved and flattened, mucro 4–6 mm, margin glabrous, pubescent outside, glabrous within; corolla tube 1.5–2.1 cm, 4–5 mm wide at mouth, pale yellow, densely pubescent externally, glabrous internally except near mouth; dorsal corolla lobe ovate, yellow, 1.9–2.2 × 1.2–1.5 cm, margin glabrous, apex with ca. 2 mm mucro, puberulous toward base externally, glabrous within; lateral corolla lobes oblong, 1.9–2 cm × 5–6 mm, rarely margin ciliate, apex nearly rounded, one side slightly folded, pubescent toward base externally, glabrous within; labellum obovate, 2.7–3.1 × 1.3–2.2 cm, 3-lobed, median lobe bifid, yellow, dark reddish maroon stripes at center, margin slightly wavy, pubescent

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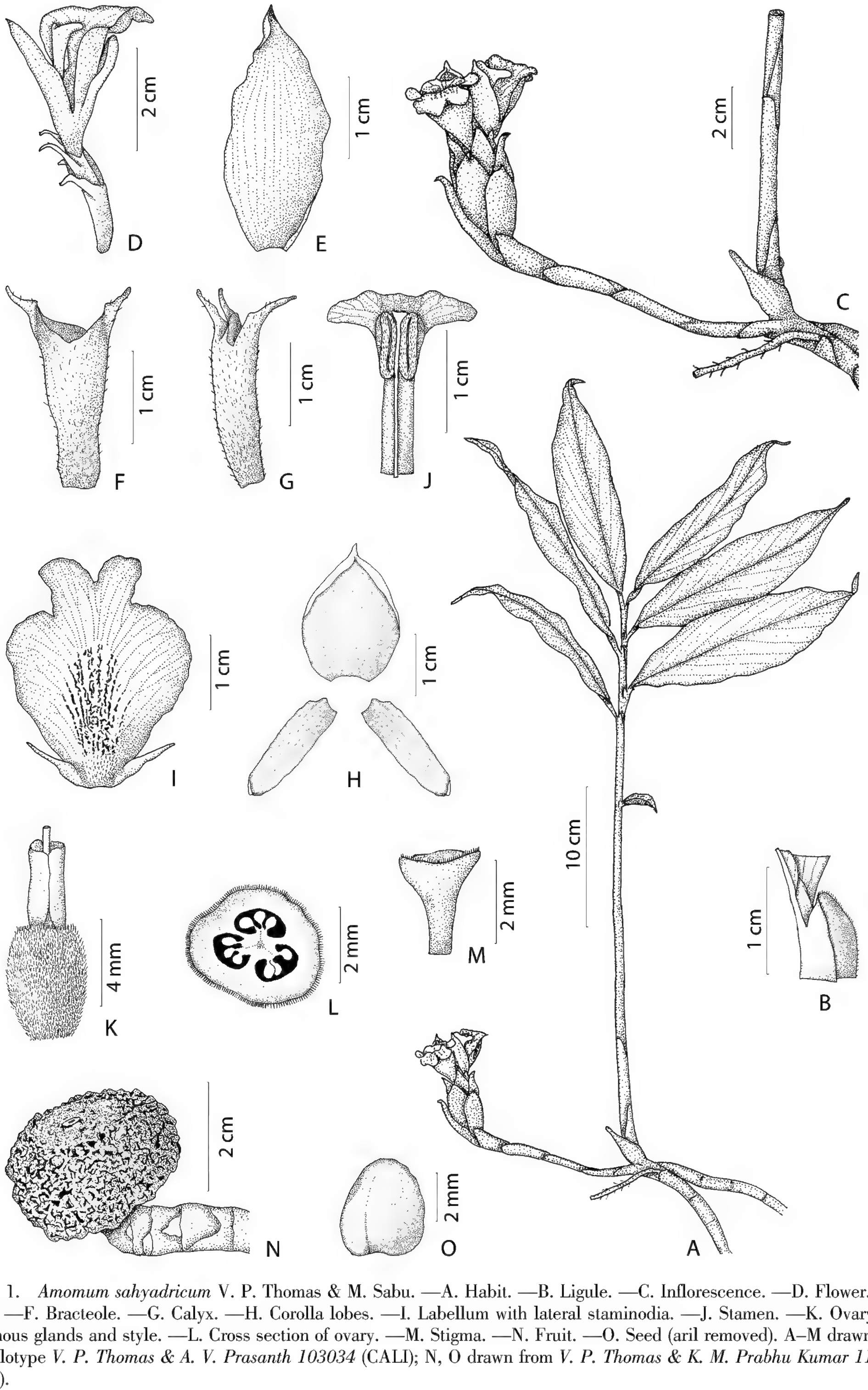

Figure 1. *Amomum sahyadricum* V. P. Thomas & M. Sabu. —A. Habit. —B. Ligule. —C. Inflorescence. —D. Flower. —E. Bract. —F. Bracteole. —G. Calyx. —H. Corolla lobes. —I. Labellum with lateral staminodia. —J. Stamen. —K. Ovary with epigynous glands and style. —L. Cross section of ovary. —M. Stigma. —N. Fruit. —O. Seed (aril removed). A–M drawn from the holotype *V. P. Thomas & A. V. Prasanth 103034* (CALI); N, O drawn from *V. P. Thomas & K. M. Prabhu Kumar 115581* (CALI).

inside near throat; lateral staminodia acute, flattened, 5–7 mm, thin, yellow, pubescent toward base, glabrous toward apex; stamen 1.7–1.9 cm, shorter than labellum, filament pale yellow, 8–10 × 2.5–3 mm, glabrous on both sides, connective glabrous, produced into crest; crest yellow, deep yellow on lateral sides, 1.4–1.5 cm × 3–4 mm, semi-lunar with truncate apex, glabrous; anther thecae oblong, 6–7 mm, creamy white, base nearly rounded, apex rounded, pubescent; dehiscence linear, complete; ovary ca. 5 × 3–4 mm, densely pubescent; locules 3, pubescent outside; ovules on axile placentae; style 3–3.6 cm, sparsely pubescent, glabrous proximally; stigma cup-shaped, ca. 1 mm across, ostiole apical, ciliate; epigynous glands 2, oblong, 3–4 mm, cream colored, apex slightly lobed, glabrous. Capsules 1 to 3 per spike, globose, 1.5–3 × 1.5–3 cm, rarely slightly 3-lobed, maroon, rarely tinged with green, rugose to muricate, pubescent externally; seeds ovate, 3–4 × 3 mm, brown, aromatic, arillate, glabrous; aril white.

Distribution and habitat. *Amomum sahyadricum* grows under evergreen forest in the Agasthyamalai Hills, Meenmutty-Kulamavu (Idukki District, Kerala) and Valparai (Coimbatore District, Tamil Nadu) of the Western Ghats, in Kerala, India, at an altitude of ca. 1000 m.s.m.

IUCN Red List category. Apart from the type locality, we were able to collect specimens of this species from two other localities in the Western Ghats. To this point, at all known sites we have located only a few populations and these may be considered to be in locations that are prone to destruction in the near future because of various human activities. According to our current knowledge of the species and using the IUCN Red List categories and criteria (IUCN, 2001, 2010), *Amomum sahyadricum* is tentatively classified as Endangered or EN B1ab(ii, iii).

Etymology. The epithet of the new species, sahyadricum, is derived from the Malayalam name of the type locality in the Western Ghats of India.

Phenology. Plants of *Amomum sahyadricum* were observed with flowers from February to March and with mature fruits in July.

Relationships. *Amomum sahyadricum* is similar to *A. muricatum* of South India in having large yellow flowers (4.2–5 cm), slender, creeping, stoloniferous rhizome and tri-lobed labellum with bifid mid-lobe. The former can be distinguished from the latter by having a smaller habit (33–60 cm), prominently raised veins on the adaxial surface of the lamina, thick and fleshy bracts, 2-horned (resembling a pair of deer antlers) bracteoles, calyx with 3 mucronate teeth, dorsal corolla lobe with mucronate apex and fruit rugose to muricate (Fig. 1). In contrast, *A. muricatum* is taller (70–150 cm) and has venation that is immersed on the leaf lamina, membranous bracts, a bracteole that lacks a horned pair, a calyx that lacks mucronate teeth, a dorsal corolla lobe with rounded apex, and echinate fruit.

Key to the Species of *Amomum* in South India

1a. Rhizome stoloniferous, rhizome length:breadth* ratio more than 10:1; habit as diffuse 2
1b. Rhizome non-stoloniferous, rhizome length: breadth ratio less than 7:1; habit as distinct clumps 6
2a. Leaves silvery, silky beneath, with appressed pubescence; labellum unlobed; fruit slightly ribbed ..... *A. hypoleucum* Thwaites
2b. Leaves pale green beneath, glabrous; labellum 3-lobed; fruit not ribbed 3
3a. Ligule 25–45 mm long, membranous .... *A. masticatorium* Thwaites
3b. Ligule 2–7 mm long, coriaceous 4
4a. Flowers 1.8–2 cm long; labellum 1.3–1.6 cm long ..... *A. agastyamalayanum*
4b. Flowers 4.2–5.3 cm long, labellum 2.5–3.3 cm long 5
5a. Bracts fleshy; bracteoles 2-lobed, 2-horned; dorsal corolla lobe with mucronate apex; fruit rugose to muricate ..... *A. sahyadricum*
5b. Bracts membranous; bracteoles 2- or 3-lobed, horns absent; dorsal corolla lobe without an apical mucro; fruit echinate ..... *A. muricatum*
6a. Ligule bifid 7
6b. Ligule entire, not bifid 8
7a. Leaves tomentose beneath; fruit winged .... *A. pterocarpum* Thwaites
7b. Leaves glabrous beneath; fruit not winged..... ..... *A. cannicarpum* (Wight) Benth. ex Baker
8a. Labellum not lobed, rhomboid; ligule 4.5–9 cm long ..... *A. nilgiricum*
8b. Labellum 3-lobed, obovate; ligule 0.5–3.8 cm long 9
9a. Bracts red; bracts and bracteoles with appressed fulvous hairs; labellum uniformly cream colored; anther crest emarginate ..... *A. fulviceps*
9b. Bracts maroon; bracts or bracteoles pubescent or puberulous; labellum with maroon design on yellow ground; anther crest fan-shaped 10
10a. Leaves glabrous beneath; flowers 5–5.5 cm long; capsule green at maturity ..... *A. newmanii*
10b. Leaves pubescent beneath; flowers 2.5–3.4 cm long; capsule maroon at maturity .... *A. ghaticum* K. G. Bhat

* Rhizome length:breadth ratio is length (including nodes and internodes) of rhizome between two adjacent aerial shoots relative to the average diameter or thickness of the rhizome.

Paratypes. INDIA. **Kerala:** Thiruvananthapuram, Agastyamala, Athirumala, 5 July 2009, *V. P. Thomas & K. M. Prabhu Kumar 115581* (CALI), 27 Feb. 2008, *V. P. Thomas & A. V. Prasanth 103023* (CALI), 2 Mar. 2008, *V. P. Thomas & A. V. Prasanth 103038* (MO), 7 Feb. 2006, *E. Sanoj 86183* (CALI); Nadukanippara, 7 Feb. 2006, *E. Sanoj 86186* (CALI); Idukki Distr., Meenmutty-Kulamavu, 24 Feb. 1984, *A. G. Pandurangan 78077* (MH). **Tamil Nadu:** way to Valparai, 31 Jan. 2006, *M. Sabu & E. Sanoj 86177* (CALI).

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Three New Species of *Paepalanthus* sect. *Diphyomene* (Eriocaulaceae) from Minas Gerais, Brazil

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Abstract. Three new species of *Paepalanthus* Mart. sect. *Diphyomene* Ruhland (Eriocaulaceae) from Minas Gerais (Brazil) are described and illustrated. *Paepalanthus arcuatus* Trovó, defined by its curved leaves, is known only from the Serra do Cipó National Park and shares morphological characters with *P. decussus* Körn. *Paepalanthus linearis* Trovó, defined by its linear leaves, is known exclusively from Itacambira and resembles *P. polycladus* Silveira. *Paepalanthus sericiscapus* Trovó, defined by its sericeous scapes, is known only from the type specimens collected in the Serra da Canastra and resembles *P. arcuatus*. All the species are known only from their type localities and are assigned a preliminary conservation status of Critically Endangered. Morphological variation, habitat, geographic distribution, and conservation status are noted.

Key words: Brazil, cerrado, Eriocaulaceae, IUCN Red List, Minas Gerais, *Paepalanthus*.

Paepalanthus Mart. sect. *Diphyomene* Ruhland comprises 15 species distributed throughout South America. This section is characterized by its unique inflorescence arranged in a tribotryum umbel-shaped structure, pistillate flowers with dolabriform sepals, and completely reduced staminodes (Trovó, 2010; Trovó et al., 2010; Trovó & Sano, 2010, 2011). In contrast to most Eriocaulaceae groups, the primary center of species diversity in *Paepalanthus* sect. *Diphyomene* is concentrated in open savannas of the Brazilian cerrados, especially in the state of Goiás (Giulietti & Hensold, 1990; Stützel, 1998; Trovó, 2010; Trovó & Sano, 2010, 2011). A secondary center of diversity for this section is in the Espinhaço Range in Minas Gerais (Brazil), where species occur in the Campos Rupestres ecoregion. All species of *Paepalanthus* sect. *Diphyomene* are narrowly distributed and usually limited to one locality, or even to a single mountain, except for the widely distributed South American species *P. chiquitensis* Herzog and *P. erectifolius* Silveira (Trovó, 2010; Trovó & Sano, 2010, 2011). As a result of fieldwork and revisionary studies of the group, we describe the following three species.

1. **Paepalanthus arcuatus** Trovó, sp. nov. TYPE: Brazil. Minas Gerais: Santana do Riacho, Parque Nacional da Serra do Cipó, "MG 010, córrego duas pontinhas," 22 May 2007, *M. L. O. Trovó, P. T. Sano, V. L. Scatena & N. L. Menezes 400* (holotype, SPF). Figure 1.

Haec species a *Paepalantho decusso* Körn. axe reproductivo breviore (ca. 4.5 vs. 5.5–8 cm longo), foliis incurvatis, capitulis dilatis (7–8 vs. 4–6 mm diam.) atque sepalis femineis apice mucronatis differt.

Herb, 32 cm tall; rhizome present, aerial stem 1.5 cm. Leaves persistent, linear to lanceolate, incurvate, patent, 5.5–7.5 × 0.3–0.4 cm, pubescent to glabrescent, margin ciliated, apex acute. Reproductive axis erect, 4.5 cm, 0.5 cm diam., glabrous; all axis bracts with similar shape, chartaceous, linear, erect to suberect, 5–5.5 × 0.3–0.4 cm, glabrous, margin ciliated, apex acute, semi-amplexicaul. Spathes 4–5 cm, glabrous, apex acute. Scapes ca. 25, arranged in an obconic umbel, 21–27.5 cm, sparsely pilose. Capitula 7–8 mm diam., discoid, white; involucral bracts in 3 to 4 series, light brown, ovate, concave, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute to obtuse; receptacle semispherical, pubescent. Flowers dimerous, ca. 46 per capitulum, ca. 45 staminate and 1 pistillate; floral bracts linear, light brown, flat, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; staminate flowers ca. 3 mm; pedicel ca. 0.5 mm, with long trichomes; sepals navicular, light brown to golden, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; fleshy antophore elongated; corolla fused, hyalines, membranaceous, ca. 1 mm; stamens ca. 1 mm; pistillodes

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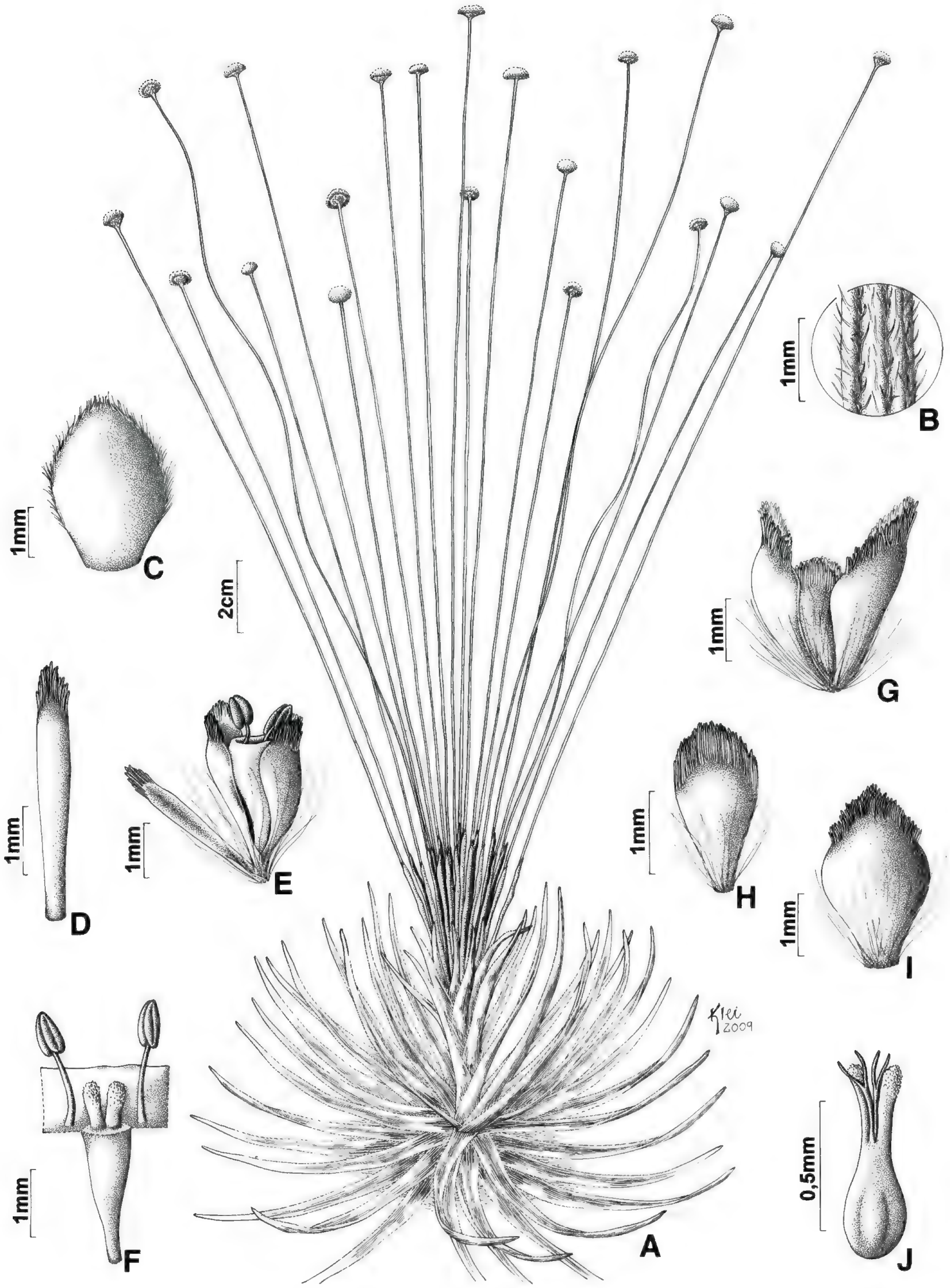

Figure 1. *Paepalanthus arcuatus* Trovó. —A. Habit. —B. Scape detail. —C. Involucral bract abaxial surface. —D. Floral bract abaxial surface. —E. Staminate flower. —F. Staminate flower with sepals removed and opened corolla. —G. Pistillate flower (juvenile). —H. Petal of the pistillate flower. —I. Sepal of the pistillate flower. —J. Gynoecium. Drawn from the holotype *M. L. O. Trovó et al. 400* (SPF).

2, papillose; pistillate flower ca. 3 mm, sessile; sepals dolabriform, light brown, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex mucronate; petals elliptic, light brown, ca. 2 mm, abaxially pubescent, margin ciliated toward the apex, apex rounded; gynoecium ca. 2 mm, stigmatic branches bifid, as large as the nectariferous branches, staminodes completely reduced. Fruits and seeds not seen.

Distribution and habitat. *Paepalanthus arcuatus* has been collected only in the Serra do Cipó National Park in Minas Gerais, growing in the rocky soils of campos rupestres. A single flowering individual was collected after a fire in Serra do Cipó in an area widely explored by botanists.

IUCN Red List category. According to IUCN Red List criteria (2001), *Paepalanthus arcuatus* is preliminarily considered Critically Endangered (CR B1a).

Phenology. A specimen with staminate flowers in full anthesis was collected in May. The single pistillate flower was in an early stage of development. Fruits and seeds were not observed.

Etymology. The epithet *arcuatus* refers to the curved leaves, an unusual characteristic within *Paepalanthus* sect. *Diphyomene*.

Discussion. *Paepalanthus arcuatus* is sympatric only with *P. erectifolius*. These two species are easily distinguished from each other by the overall stature, as *P. erectifolius* is usually more than 1 m high. *Paepalanthus arcuatus* is also distinguished from other species of the section by its pubescent scapes and incurvate leaves. This new species is morphologically most similar to *P. decussus* Körn. The scapes in both species are arranged in an obconic umbel, the reproductive axis bracts have a similar shape, and the scapes and trichomes are equally large. However, *P. arcuatus* differs from *P. decussus* in various ways, including a shorter and glabrous reproductive axis, incurvate leaves, longer spathes, wider capitula, and the mucronate apex of the pistillate flower sepals (Table 1). *Paepalanthus decussus* has been seen only near the town of Ouro Preto in Minas Gerais, and *P. arcuatus* is known only from Serra do Cipó National Park also in Minas Gerais; the two species are allopatric.

Table 1. Morphological differences between *Paepalanthus arcuatus* and *P. decussus*.

	P. arcuatus	*P. decussus*
Reproductive axis size (cm)	4.5	5.5–8
Leaf transversal position	incurvate	flat
Spathe size (cm)	4–5	3–4
Capitula width (cm)	0.7–0.8	0.4–0.6
Apex of sepal in the pistillate flowers	mucronate	obtuse

2. Paepalanthus linearis Trovó, sp. nov. TYPE: Brazil. Minas Gerais: Itacambira "Plantar MG 15—Fazenda Tamanduá," 10 Apr. 2005, *E. Tameirão Neto 4216* (holotype, SPF; isotype, BHCB). Figure 2.

Haec species a *Paepalantho arcuato* Trovó foliis planis brevioribus (1.5–2 vs. 5.5–7.5 cm longis), axis reproductivi bracteis lanceolatis brevioribus (2.5–3.5 vs. 5–5.5 cm longis), scapis sericeis brevioribus (13.5–15 vs. 21–27.5 cm longis) atque floribus femineis pedicellatis differt.

Herb, 51–60 cm tall; rhizome present, aerial stem 0.5–1.5 cm. Leaves deciduous, linear, flat, semi-erect, 3.5–13 × 0.1–0.2 cm, pubescent to glabrescent, margin ciliated, apex acute. Reproductive axis erect, 31–40 cm, 0.4 cm diam., glabrous; all axis bracts with same shape, chartaceous, linear to lanceolate, erect to suberect, 2–4 × 0.2–0.4 cm, glabrous, margin glabrous, apex acute, semi-amplexicaul. Spathes 2–3.5 cm, glabrous, apex acute. Scapes 25 to 53, arranged in a semispherical umbel, 21–25.5 cm, pubescent toward the apex. Capitula 6–8 mm diam., semispherical, white; involucral bracts in 4 to 5 series, brown, ovate, concave, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; receptacle semispherical, pubescent. Flowers dimerous, ca. 320 per capitulum, ca. 240 staminate and 80 pistillate; floral bracts linear, light brown, flat, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex acute; staminate flowers ca. 3 mm; pedicel ca. 0.5 mm, with long trichomes; sepals navicular, light brown to golden, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex acute; fleshy antophore elongated; corolla fused, hyalines, membranaceous, ca. 1 mm long; stamens ca. 1 mm; pistillodes 2, papillose; pistillate flowers ca. 3 mm, sessile, disposed in concentric rings; sepals dolabriform, light brown to gold, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex mucronate; petals elliptic, light brown to golden, ca. 2 mm, abaxially pubescent, margin ciliated toward the apex, apex rounded; gynoecium ca. 2 mm, stigmatic branches bifid, same size as the nectariferous branches, staminodes completely reduced. Fruit a loculicidal capsule. Seeds ca. 1 mm, reticulate surface, red to brownish.

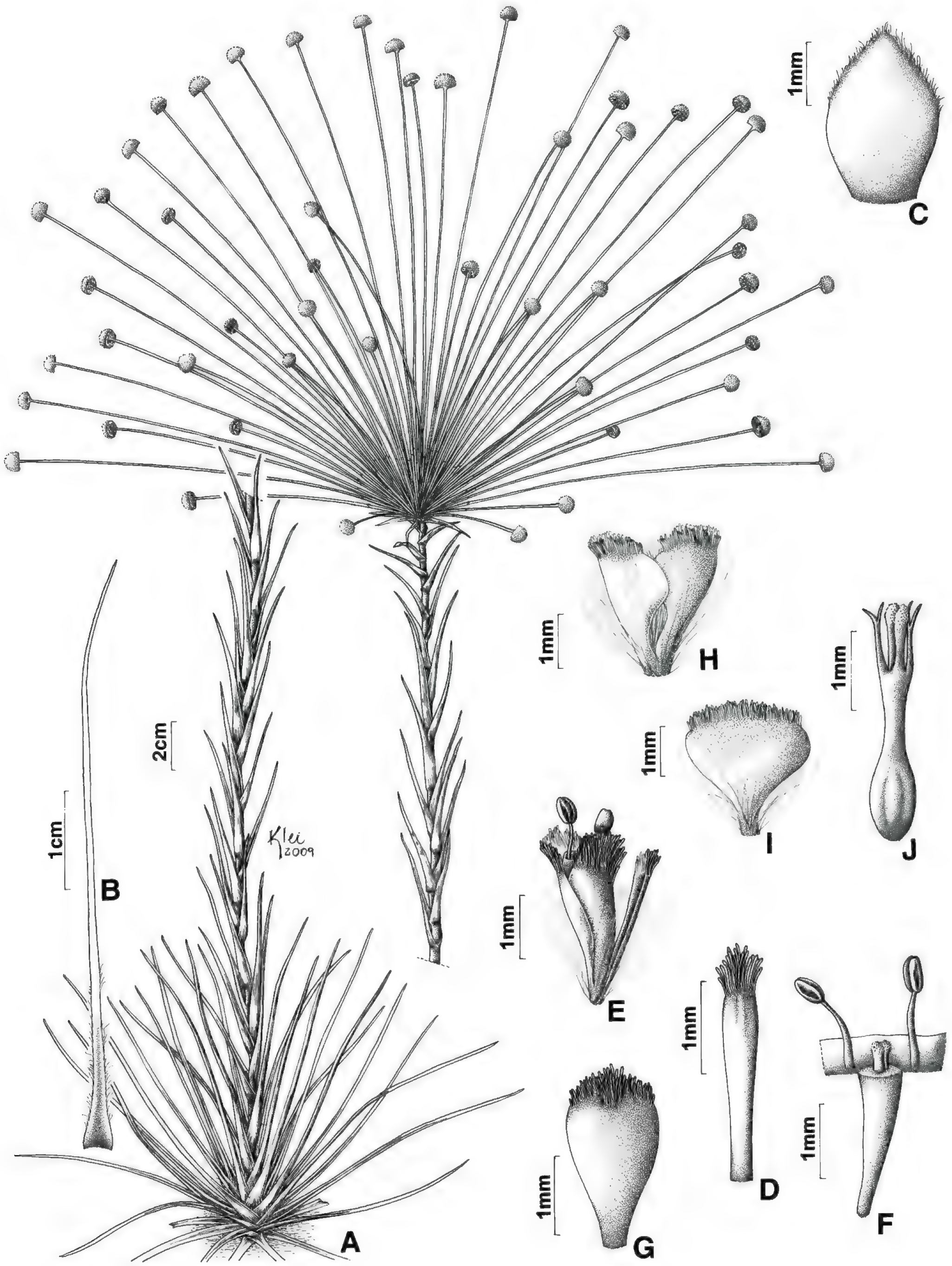

Figure 2. *Paepalanthus linearis* Trovó. —A. Habit. —B. Leaf detail. —C. Involucral bract abaxial surface. —D. Floral bract abaxial surface. —E. Staminate flower. —F. Staminate flower with sepals removed and opened corolla. —G. Sepal of the staminate flower. —H. Pistillate flower. —I. Sepal of the pistillate flower. —J. Gynoecium. Drawn from the holotype *E. Tameirão Neto 4216* (SPF).

Distribution and habitat. *Paepalanthus linearis* is restricted to a single locality in the mountains to the north of the Espinhaço Range near Itacambira in Minas Gerais. The two collections came from the same population in grass-dominated open savanna.

IUCN Red List category. According to IUCN Red List criteria (2001), *Paepalanthus linearis* is preliminarily considered Critically Endangered (CR B1ab+B2a).

Phenology. Individuals with staminate and pistillate flowers in full anthesis were collected in April. Fruits were collected in October.

Etymology. The epithet *linearis* refers to the linear leaves, which are usually deciduous in mature individuals.

Discussion. *Paepalanthus linearis* is the only species of the section that is known to occur in the northern portion of the Espinhaço Range in Minas Gerais. It can be distinguished from the other species of *Paepalanthus* sect. *Diphyomene* by its unusual semi-erect and linear leaves. In *P. amoenus* (Bong.) Körn., another species from Minas Gerais, the leaves are also linear, but in comparison with those of the new species are smaller and patent. These species are allopatric, as *P. amoenus* is confined to the south of the Espinhaço Range.

Paepalanthus linearis and *P. polycladus* are morphologically very similar. The reproductive axis and scapes of both are the same approximate size, and both have deciduous leaves. *Paepalanthus linearis* is distinguished from the latter species by its semi-erect and linear leaves, relatively smaller size of spathes and capitula (Table 2), and characters from the pistillate flowers, including sepals with mucronate apex, petals abaxially pubescent, and stigmatic branches the same size as the nectariferous branches. Moreover, the species are allopatric, as *P. polycladus* is endemic to the Serra da Canastra National Park.

Paratype. BRAZIL. **Minas Gerais:** Itacambira, Plantar "MG 15—Fazenda Tamanduá," 9 Oct. 2005, *E. Tameirão Neto 4052* (BHCB, SPF).

3. Paepalanthus sericiscapus Trovó, sp. nov. TYPE: Brazil. Minas Gerais: São Roque de Minas, Parque Nacional da Serra da Canastra "Chapadão do Diamante," 16 July 1995, *R. Romero, J. N. Nakajima, R. Oliveira, P. E. Oliveira & I. Schiavini 2464* (holotype, SPF; isotype, HUFU). Figure 3.

Haec species a *Paepalantho polyclado* Silveira foliis linearibus semierectis, spathis brevioribus (2–3.5 vs. 3.5–8 cm longis), capitulis angustioribus (6–8 vs. 8–12 mm diam.), sepalis femineis apice mucronatis, petalis abaxialiter pubescentibus apicem versus ciliatis atque stylo ramis stigmaticis et nectariferis aequantibus differt.

Herb, 15–20 cm tall; rhizome absent, aerial stem 0.5 cm. Leaves persistent, lanceolate, flat, patent, 1.5–2 × 0.4–0.6 cm, glabrous, margin glabrous, apex acute. Reproductive axis erect, 3.5–4 cm, 0.5 cm diam., glabrous; all axis bracts with same shape, chartaceous, lanceolate, suberect, 2.5–3.5 × 0.3–0.5 cm, glabrous, margin ciliated, apex acute, semi-amplexicaul. Spathes 2.5–3 cm, glabrous, apex acute. Scapes 11 to 17, arranged in an obconic umbel, 13.5–15 cm, sericeous. Capitula 7–9 cm diam., discoid to semispherical, white; involucral bracts in 3 to 4 series, light brown, ovate, concave, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute to obtuse; receptacle semispherical, pubescent. Flowers dimerous, ca. 180 per capitulum, ca. 150 staminate and 30 pistillate; floral bracts linear, brown, flat, ca. 2 mm, glabrous, margin ciliated toward the apex, apex acute; staminate flowers ca. 3 mm; pedicel ca. 0.5 mm, with long trichomes; sepals navicular, light brown, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; fleshy anthophore elongated; corolla fused, hyalines, membranaceous, ca. 1 mm; stamens ca. 1 mm; pistillodes 2, papillose; pistillate flower ca. 3 mm, pedicel 3 mm; sepals dolabriform to navicular, light brown, ca. 3 mm, glabrous, margin ciliated toward the apex, apex

Table 2. Morphological differences between *Paepalanthus linearis* and *P. polycladus*.

	P. linearis	*P. polycladus*
Leaf form	linear	lanceolate
Leaf orientation	semierect	patent
Spathe size (cm)	2–3.5	3.5–8
Capitula size (cm)	0.6–0.8	0.8–1.2
Apex of the pistillate flower sepal	mucronate	obtuse
Trichomes of sepal of the pistillate flowers	restricted to the base	apex and center
Stigmatic branches/nectariferous branches	same size	twice longer

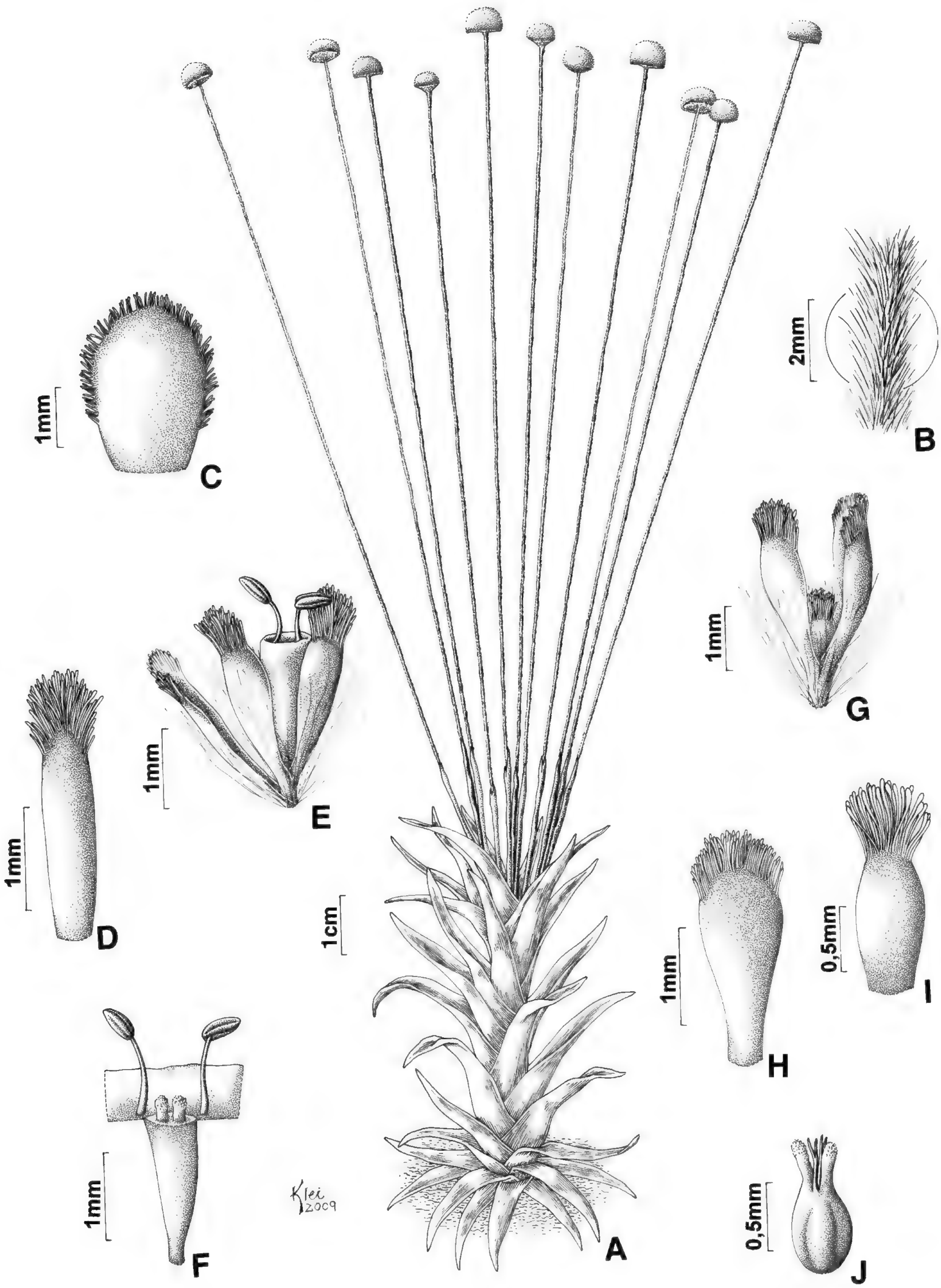

Figure 3. *Paepalanthus sericiscapus* Trovó. —A. Habit. —B. Scape detail. —C. Involucral bract abaxial surface. —D. Floral bract abaxial surface. —E. Staminate flower. —F. Staminate flower with sepals removed and opened corolla. —G. Pistillate flower (juvenile). —H. Sepal of the pistillate flower. —I. Petal of the pistillate flower. —J. Gynoecium. Drawn from the holotype *R. Romero et al. 2464* (SPF).

Table 3. Morphological differences between *Paepalanthus sericiscapus* and *P. arcuatus*.

	P. sericiscapus	*P. arcuatus*
Leaf transversal position	flat	incurvate
Leaf size (cm)	1.5–2	5.5–7.5
Reproductive axis bract form	lanceolate	linear
Reproductive axis bract size (cm)	2.5–3.5	5–5.5
Scape size (cm)	13.5–15	21–27.5
Scape trichomes	sericeous	pubescent
Pedicel of the pistillate flower	present	absent

acute; petals elliptic, hyaline, ca. 1 mm, glabrous, margin ciliated toward the apex, apex rounded; gynoecium ca. 1 mm, stigmatic branches bifid, as large as the nectariferous branches, staminodes completely reduced. Fruits and seeds not seen.

Distribution and habitat. *Paepalanthus sericiscapus* is known only from the type collection in the Serra da Canastra National Park, concurring with grasses in campos rupestres.

IUCN Red List category. According to IUCN Red List criteria (2001), *Paepalanthus sericiscapus* is preliminarily considered Critically Endangered (CR B1a).

Phenology. Individuals with staminate flowers in anthesis were collected in July. The pistillate flowers were in an early stage of development. Fruits and seeds were not encountered.

Etymology. The epithet *sericiscapus* refers to the distinctive densely sericeous scapes.

Discussion. The sericeous scapes of *Paepalanthus sericiscapus* are unique among the other species in *Paepalanthus* sect. *Diphyomene*, which have glabrous scapes (except *P. decussus* and *P. arcuatus*, which have sparsely pilose scapes). The presence of pedicels and the navicular to dolabriform petals of the pistillate flower are also remarkable in this new species. *Paepalanthus sericiscapus* is sympatric with *P. polycladus* Silveira and *P. chiquitensis*, but it is distinguished from those species by its relatively shorter stature.

Paepalanthus sericiscapus is morphologically related to *P. arcuatus*. These species are two of the smallest species within the section, both not surpassing ca. 30 cm in stature. Capitula width and the obconic scape arrangement are also similar among these taxa. Apart from the pubescent scapes and the floral characteristics stated above, *P. sericiscapus* is distinguished from *P. arcuatus* by its shorter, flat leaves and shorter, lanceolate reproductive axis bracts (Table 3).

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Appendix 1. Additional Specimens Used for Morphological Comparisons.

Paepalanthus decussus Körn., BRAZIL. **Minas Gerais:** Ouro Preto, s.d., *Claussen s.n.* (BR); Mariana, 4 Apr. 2008, *Messias 1963* (OUPR).

Paepalanthus polycladus Silveira, BRAZIL. **Minas Gerais:** São Roque de Minas, 18 Apr. 1982, *Castro 306*, *307* (SPF); 16 Apr. 1994, *Romero et al. 844* (SPF); 18 Mar. 1995, *Nakajima et al. 867*, *882* (SPF); 10 May 1995, *Nakajima et al. 1009* (SPF); 11 May 1995, *Romero et al. 2219* (SPF); 15 July 1995, *Romero et al. 2420* (SPF); 18 July 1995, *Nakajima et al. 1257* (SPF); 28 Sep. 1995, *Romero et al. 2995* (SPF); 19 Mar. 1998, *Sano et al. 942* (SPF); 15 May 2007, *Trovó & Watanabe 391* (SPF).

Bauhinia hekouensis (Leguminosae, Caesalpinioideae), a New Species from Yunnan, China

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ABSTRACT. *Bauhinia hekouensis* T. Y. Tu & D. X. Zhang (Leguminosae, Caesalpinioideae), a narrow endemic from Hekou County, Yunnan Province, in southwestern China, is described and illustrated. The new species can be diagnosed by a combination of characters, including tendrilled lianas; bilobed leaves with nine to 11 nerves; terminal, racemose inflorescences; spindle-shaped, slightly falcate flower buds with acute apices; tubular hypanthium; five freely reflexed sepals during anthesis; and large white flowers with oblanceolate, crisped petal blades. The general morphology suggests an affinity of the new species to series *Clavatae* (de Wit) Wunderlin of section *Phanera* (Lour.) Wunderlin in *Bauhinia* L., especially to the species *B. coccinea* (Lour.) DC. and *B. nervosa* (Wall. ex Benth.) Baker.

Key words: *Bauhinia*, Caesalpinioideae, China, IUCN Red List, Leguminosae.

The legume genus *Bauhinia* L. comprises ca. 300 species of trees, shrubs, and lianas. As the largest genus of the tribe Cercideae (Leguminosae, Caesalpinioideae), it occurs throughout pantropic areas, with its two centers of diversity being southeastern Asia and South America, extending into southern North America (Wunderlin et al., 1987). Forty-two species of *Bauhinia* from China were documented in the *Flora Reipublicae Popularis Sinica* (Chen, 1988), and several additional species have been subsequently described or recorded (Zhang, 1993; Zhang & Chen, 1996, 1998). There are 47 species recognized in the recently published *Flora of China* (Chen et al., 2010). During an exploration for *Bauhinia* in southwestern China as part of our long-term endeavor on the systematics and evolution of the genus, an apparently new species was discovered. The new species exhibits characteristics of the series *Clavatae* (de Wit) Wunderlin in *Bauhinia*, from section *Phanera* (Lour.) Wunderlin, subgenus *Phanera* (Lour.) Wunderlin, K. Larsen & S. S. Larsen. It shows close affinities to *B. coccinea* (Lour.) DC. and *B. nervosa* (Wall. & Benth.) Baker. *Bauhinia* ser. *Clavatae* consists of ca. 22 species occurring in tropical southeastern Asia (de Wit, 1956; Larsen et al., 1980; Wunderlin et al., 1987), with one species and one subspecies previously recorded from Yunnan Province of China (Chen et al., 2010).

Bauhinia hekouensis T. Y. Tu & D. X. Zhang, sp. nov. TYPE: China. Yunnan: Hekou Co., Nanxi Town, Baishahe, 22°41.237′N, 103°57.597′E, 169 m, near stream, 11 Oct. 2008, *T. Tu 511* (holotype, IBSC; isotypes, IBSC, KUN). Figure 1.

Haec species a *Bauhinia coccinea* (Lour.) DC. et *B. nervosa* (Wall. ex Benth.) Baker petiolo 2.5–6 (nec 1.5–3) cm longo, alabastro fusiformi (nec ovato nec elliptico) leviter falcato apice acuto atque petalis albis lamina oblanceolata crispata differt.

Large liana, extending into upper canopies of host trees (4–10 m); tendrils on young branches densely pubescent, singly inserted at nodes; branchlets terete, pubescent when young, gradually glabrescent. Leaves ovate to suborbicular, up to 12 × 14 cm; the blades bifid to 1/3 divided with a broad sinus, coriaceous to chartaceous, blade surface brownish pubescent when young to glabrate, blade base cordate, with primary nerves 9 to 11, stout, connected by transverse secondary nerves; petioles green, 2.5–6 cm; stipules deciduous, obovate, rotund or orbicular, ca. 3–6 × 2–4 mm, glabrous or minutely puberulent. Inflorescences racemose, terminal, unbranched, 5–25 cm; axis greenish pubescent, with up to ca. 30 flowers; pedicels slender, 2.1–3.4 cm, puberulent; bracts lanceolate, green, 10–15 × 2–3 mm; bracteoles linear, acute, 4–8 mm, inserted above the middle of the pedicels. Flower buds green, spindle-shaped, slightly falcate, apex acute, 15–25 × 3–5 mm; hypanthium tubular, 17–21 × 1.5–2.5 mm; calyx green, splitting into 5 sepals on the apex of the hypanthium, acicular, subulate, reflexed at anthesis, 1.8–2.5 cm; petals arranged along the dorsal side of the flower, subequal, blades white, crisped, the lower surface and edges of the upper surface sparsely pubescent, the median zone of

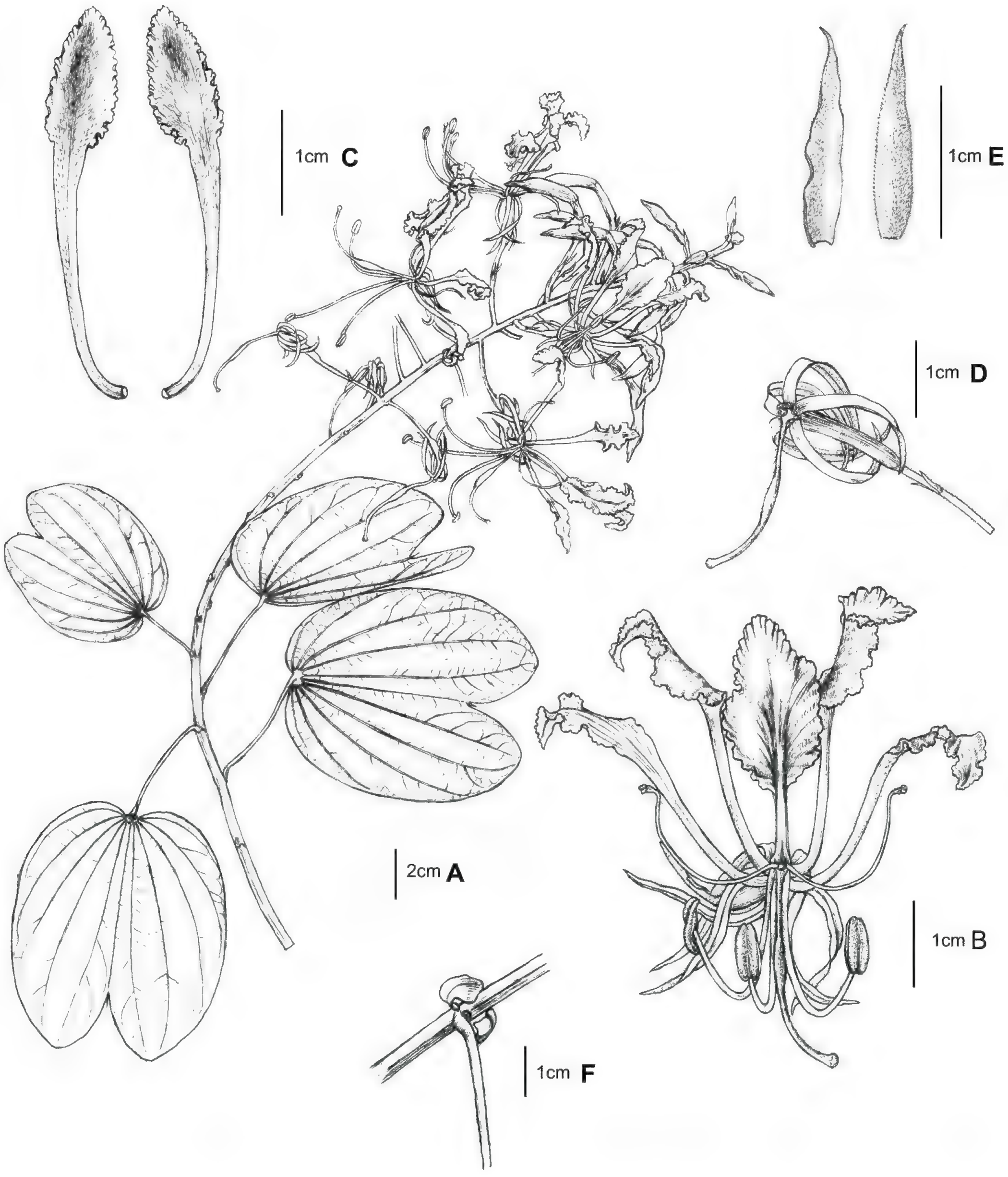

Figure 1. *Bauhinia hekouensis* T. Y. Tu & D. X. Zhang. —A. Branch in flower. —B. Flower. —C. Petals. —D. Young fruits. —E. Bracts. —F. Stipules. Illustrations prepared by Yunxiao Liu from the holotype *T. Tu 511* (IBSC).

the upper surface densely pubescent; the posterior blade of the corolla oblanceolate, the lower part of the blade gradually, the upper part of the blade more abruptly, narrowing to the apices, 14–22 × 5–9 mm; the blades of the lateral petals slightly narrower than the posterior ones, 12–21 × 3–9 mm; the petal claws green, equal to or slightly longer than petal blades, ± pubescent; fertile stamens 3, opposite to the petals; filaments green, glabrous, 32–47 mm, starting outward and then reflexing upward; anthers maroon, elliptic, 3–4 mm, opening by longitudinal slits; staminodes 2, filiform, 1 mm; ovary densely pubescent, on a 8–15 mm stipe; style pubescent, 12–19 mm; stigma green, capitate. Pods flattened, pubescent when young, later glabrous.

Distribution and habitat. *Bauhinia hekouensis* is currently known only from the type locality in a

tropical rainforest in a ravine in Hekou County, Yunnan Province, in southwestern China. Similar habitats are common in Hekou County, whereas many places in this region have been deforested due to the planting of banana and rubber trees. Two other *Bauhinia* species, *B. wuzhengyii* S. S. Larsen and *B. touranensis* Gapnep., co-occur with *B. hekouensis* at the type locality.

IUCN Red List category. *Bauhinia hekouensis* was observed from a single population with four individuals at the type locality. Banana plantings have been found within ca. 50 m of the type locality, disturbing its habitat. *Bauhinia hekouensis* may also be threatened by tourism, because a small dam and a restaurant have been built for tourists near a waterfall in the type locality. Due to the species' restricted occurrence, small population size, and disturbed habitat, *B. hekouensis* should be considered as Critically Endangered (CR), according to IUCN Red List criteria (IUCN, 2001).

Discussion. *Bauhinia hekouensis* is a remarkable species with spindle-shaped, slightly falcate buds, large white flowers, and five free sepals that are reflexed at anthesis. The general morphology suggests that the new species be assigned to *Bauhinia* ser. *Clavatae*, a series of section *Phanera* that is characterized by flowers arranged in racemes; hypanthium up to 3.5 cm; buds oblong or ellipsoid; sepals free, reflexed at anthesis; and stamens equaling or longer than the petals, bearing 7–25 mm, oblong-elliptic anthers (de Wit, 1956; Wunderlin et al., 1987). The leaf shape, flower size, petal blades, and claws of the new species suggest a close relationship to *B. coccinea* subsp. *coccinea*, *B. coccinea* subsp. *tonkinensis* (Gagnep.) K. Larsen & S. S. Larsen, and *B. nervosa*. Geographically, the new species is within the distributional ranges of *B. coccinea* subsp. *tonkinensis*, found in northern Vietnam and southwestern China, and *B. nervosa*, found in Thailand, India, Myanmar, and southwestern China. However, *B. hekouensis* is not sympatric with *B. coccinea* subsp. *coccinea*, which is known from Laos and Vietnam (Larsen et al., 1980; Chen, 1988). The new species differs from the two subspecies of *B. coccinea* and *B. nervosa* by the length of its petioles, which are 2.5–6 cm long (vs. 2.0–2.5 cm long in *B. coccinea* subsp. *coccinea*, 1.5–3 cm long in *B. coccinea* subsp. *tonkinensis*, and 1.5–2.8 cm long in *B. nervosa*); the spindle-shaped, slightly falcate buds (elliptic); the acute bud apices; and the white petals with narrower, oblanceolate, crisped blades (Table 1). In the key to *Flora of China* by Chen et al. (2010), the new species would key to *B. nervosa*, from which

Table 1. Diagnostic morphological characteristics of *Bauhinia hekouensis* compared with those of *B. nervosa* and two subspecies of *B. coccinea*.

Characters	*B. hekouensis*	*B. coccinea* subsp. *coccinea*	*B. coccinea* subsp. *tonkinensis*	*B. nervosa*
Leaves	ovate to suborbicular, up to 14 cm	ovate to elliptic, up to 8 × 6 cm	ovate to elliptic, up to 8 × 6 cm	suborbicular, up to 7 × 7.4 cm
Petioles	2.5–6 cm	2.0–2.5 cm	1.5–3 cm	1.5–2.8 cm
Pedicels	2.1–3.4 cm	6–9 cm	<3 cm	4–4.5 cm
Hypanthium	tubular, 17–21 mm	tubular, 10–15 mm	tubular, 10–15 mm	tubular, ca. 20 mm
Flower buds	spindle-shaped, 15–25 × 3–5 mm	ellipsoid, 15–20 × 7 mm	ellipsoid, 15–18 × 6–8 mm	ellipsoid, 18–22 × 7–9 mm
Petal blades	crisped, oblanceolate, 12–22 × 3–9 mm	smooth, obovate, 22–32 × 13–22 mm	smooth, elliptic or obovate, 15–17 × 10–13 mm	smooth, broadly obovate, ca. 30 × 20 mm
Petal claws	12–25 mm	15–20 mm	5–8 mm	ca. 20 mm
Petal color	white	red	red to orange	white to yellowish, reddish at base
Geographic distribution	Yunnan, China	Vietnam, Laos	Yunnan, China; Vietnam	Yunnan, China; India; Myanmar; Thailand

it differs by its bud shape and size and petal shape, size, and color.

Paratypes. CHINA. **Yunnan:** Hekou Co., Nanxi Town, Baishahe, 11 Oct. 2008, *T. Y. Tu 510*, *512* (IBSC); 31 Oct. 2011, *T. Y. Tu 618* (IBSC, KUN, MO); 15 Jan. 2010, *G. B. O. W. S. 1240* (IBSC, KUN).

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Studies in Andean *Ocotea* (Lauraceae) II. Species with Hermaphrodite Flowers and Densely Pubescent Lower Leaf Surfaces, Occurring Above 1000 Meters in Altitude

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Abstract. A revision of the Andean species of *Ocotea* Aubl. (Lauraceae) with hermaphrodite flowers and the lower leaf surface completely covered by the pubescence is presented. A key to the 22 recognized species is provided. Fourteen species are described as new: *O. comata* van der Werff, *O. micrantha* van der Werff, and *O. stenophylla* van der Werff from Bolivia; *O. gentryi* van der Werff, *O. pedicellata* van der Werff, and *O. umbrina* van der Werff from Colombia; *O. loxensis* van der Werff, *O. palaciosii* van der Werff, *O. pautensis* van der Werff from Ecuador; *O. andina* van der Werff, *O. glabriflora* van der Werff, *O. pajonalis* van der Werff, and *O. trematifera* van der Werff from Peru; and finally, the single species *O. guaramacalensis* van der Werff from Venezuela. Lectotypification is provided for the name *O. jelskii* Mez.

Key words: Andes, Bolivia, Colombia, Ecuador, IUCN Red List, Lauraceae, *Ocotea*, Peru, Venezuela.

In this second part of a revision of the Andean species of *Ocotea* Aubl., the 22 species with hermaphrodite flowers, solid twigs, and densely pubescent leaves with the lower surface completely covered by the pubescence, are treated. *Ocotea* is the largest genus of the Lauraceae in the New World, with an estimated 300 (Rohwer, 1993) or 350 to 400 species (van der Werff, 2011). The American species of *Ocotea* were last revised by Mez (1889), and a considerable number of species have been described since then. The large number of species makes a revision of the entire genus beyond the scope of most botanists. The Missouri Botanical Garden has had, and still has, several collecting programs in the Andean parts of South America, which has resulted in a large number of collections. Therefore, I decided to revise the Andean species, those species occurring above 1000 m altitude. The altitudinal limit was chosen to avoid the considerable number of lowland species in northern South America. The first part of this project included a revision of the species with hermaphrodite flowers and hollow twigs (van der Werff, 2012); one of the species treated in that publication (*O. beekmanii* van der Werff) had the lower leaf surface completely covered by the indument. Details about floristic studies of *Ocotea* and a survey of historic collectors can be found in the introduction of this first part.

Ocotea is characterized by flowers with six equal tepals, nine 4-locular stamens, the locelli arranged in two superposed pairs, a lack of staminodia or, when present, stipitiform staminodia, and the fruit seated in a shallow or deep cupule. Flowers can be unisexual or perfect. Rohwer (1986) gave an overview of the genus, including keys to species groups and species, largely based on a study of type specimens. This publication has facilitated subsequent studies greatly and described informally a large number of species groups. Chanderbali et al. (2001) published a large phylogeny of Neotropical Lauraceae and showed that *Ocotea* as traditionally circumscribed is almost certainly polyphyletic. Unfortunately, the number of South American species included in Chanderbali et al. (2001) was small (only 15 species out of an estimated 200), and it is premature to attempt to define distinct clades among the South American species. A better knowledge of the species as well as a larger number of DNA samples are needed before *Ocotea* can be divided in monophyletic groups. A practical approach to a better understanding of the species is to revise groups of species based on readily visible morphological characters, realizing that such groups will probably not be monophyletic.

The *Ocotea* group revised here is characterized by hermaphrodite flowers, solid twigs, and a dense pubescence completely covering the lower leaf surface. In most species the pubescence consists of short, erect, curly hairs that form a closed tomentellous to tomentose cover on the lamina. On flowering specimens the color of the pubescence is often reddish brown or ferruginous; less frequently it is yellow-brown or pale brown. In three species the pubescence consists of appressed hairs. The indument wears off with age, especially in the species with appressed hairs; it is more persistent in the species with erect, curly hairs. The color of the pubescence also changes from reddish brown to pale brown with age. All except two species only occur

above 2000 m. The exceptions are *O. palaciosii* van der Werff and *O. terciopelo* C. K. Allen; however, these two species also are found above 2000 m. The pubescence on the lower leaf surface of *O. heterochroma* Mez & Sodiro does not always cover the leaf surface entirely. Therefore, this species will also be treated in the group of species with the pubescence not covering the leaf surface completely.

The key is based on flowering specimens; fruiting specimens can be identified only by matching them with flowering material. An important character is the presence or absence of pubescence on the inner surface of the receptacle. This is best seen by splitting a dried flower lengthwise with a sharp blade. The pubescence is difficult to see on boiled, wet flowers. A few species have distinctive cupules; these include *Ocotea arnottiana* (Nees) van der Werff, which has persistent tepals on the margin of the cupules, as well as *O. benthamiana* Mez and *O. heterochroma*, both of which have cupules with a double margin. Another unusual feature is the presence of domatia in *O. trematifera* van der Werff. Usually, domatia are nearly always visible as axillary tufts of hairs or depressions in the axils of the secondary veins. However, *O. trematifera* has domatia formed by an absence of pubescence, visible as small holes in the tomentellous cover. They function the same way as domatia formed by tufts of hairs, as shelter for mites.

Of the 22 species treated here, 14 are new to science. Four new species are found in Peru, three each in Bolivia, Ecuador, and Colombia, and one in Venezuela. There are certainly additional new species to be described. Several fruiting collections cannot be matched with flowering specimens, and few collections are available from Venezuela and Colombia due to a combination of a lack of specimens and to bureaucratic regulations making the export of specimens nearly impossible.

Conservation assessments are given for all species, using IUCN (2001) criteria. These assessments should be considered as provisional, because of the small number of available collections and the fact that collecting density has been uneven in the Andean region. The number of collections from Colombia is especially low, and in Peru there are almost no collections from the departments of La Libertad, Ancash, and Huanuco.

KEY TO THE ANDEAN SPECIES OF *OCOTEA* WITH HERMAPHRODITE FLOWERS, SOLID TWIGS, AND THE LOWER LEAF SURFACE COMPLETELY COVERED BY PUBESCENCE AND THAT OCCUR ABOVE 1000 M ALTITUDE

1a. Leaf base revolute and decurrent on the petiole ... 2
1b. Leaf base plane or sometimes reflexed, but not decurrent on the petiole 3
2a. Tertiary venation reticulate, prominently raised on the lower surface ..... 10. *O. infrafoveolata*
2b. Tertiary venation scalariform, faintly raised on the lower surface ..... 4. *O. cardinalis*
3a. Domatia (inconspicuous) present as small pits in the axils of the secondary veins on the lower leaf surface ..... 21. *O. trematifera*
3b. Domatia absent 4
4a. Inner surface of the receptacle pubescent 5
4b. Inner surface of the receptacle glabrous 16
5a. Leaf bases rounded to obtuse; leaves to 1.5 times longer than wide 6
5b. Leaf bases obtuse to acute or cuneate, more than 1.5 times longer than wide; if leaves, occasionally ca. 1.5 times longer than wide, then leaf base shortly attenuate 7
6a. Midrib and secondary veins immersed on the upper leaf surface; secondary veins 4 to 6, the lowermost two closer together than the more distal ones; indument on the lower leaf surface ferruginous; tepals papillose near the tips, otherwise glabrous on the inner surface ..... 18. *O. rotundata*
6b. Midrib and secondary veins impressed on the upper leaf surface; secondary veins 6 to 8, evenly spaced; indument on lower leaf surface the color of raw umber; tepals pubescent on the inner surface ..... 22. *O. umbrina*
7a. Tertiary venation reticulate and raised on the lower leaf surface; venation usually lighter in color than the surrounding lamina tissue ..... 14. *O. pajonalis*
7b. Tertiary venation immersed or raised on the lower leaf surface; if raised, tertiary venation scalariform 8
8a. Outer surface of hypanthium densely pubescent, outer surface of tepals glabrous or nearly so 9
8b. Outer surface of hypanthium and tepals with similar density of indument or tepals slightly less densely pubescent than receptacle 10
9a. Leaves 12–27 cm; petioles 1.7–2.8 cm long; indument on lower surface of leaves ferruginous brown ..... 3. *O. benthamiana*
9b. Leaves to 10 cm; petioles to 0.8 cm long; indument on lower leaf surface brown ..... 6. *O. gentryi*
10a. Midrib and secondary veins impressed on the upper surface of the leaves 11
10b. Midrib and secondary veins immersed on the upper surface of the leaves 13
11a. Petioles deeply canaliculate; indument on lower leaf surface ferruginous, secondary veins 5 or 6 on each side ..... 15. *O. palaciosii*
11b. Petioles flat above; indument on lower leaf surface leathery brown or umber; secondary veins 8 to 11 on each side 12
12a. Leaf bases shortly attenuate, pubescence on lower leaf surface brown; inflorescences 15–20 cm ..... 16. *O. pautensis*
12b. Leaf bases rounded, pubescence on lower leaf surface the color of raw umber; inflorescences to 10 cm ..... 22. *O. umbrina*
13a. Mature leaves more than 15 cm ..... 1. *O. andina*
13b. Mature leaves to 12 cm 14
14a. Pubescence on the lower leaf surface ferruginous; tepals spreading at anthesis; leaf tip slender, acute to acuminate ..... 19. *O. stenophylla*

14b. Pubescence on the lower leaf surface brown or whitish; tepals erect or half erect at anthesis; leaf tips obtuse or bluntly acute 15
15a. Indument of twigs and terminal buds dense, consisting of very short, appressed hairs; secondary veins raised on the lower surface, readily visible; leaf apex obtuse, leaves broadly elliptic to slightly obovate ... 8. *O. guaramacalensis*
15b. Indument of twigs and terminal buds tomentellous to tomentose, the hairs ascending to erect; secondary veins immersed, poorly visible; leaf apex acute to acuminate, leaves narrowly elliptic to lanceolate ..... 11. *O. jelskii*
16a. Hairs on the lower leaf surface straight, appressed or ascending, 0.5–1 mm long, free at the base but groups of hairs with the distal half twisted together, the indument pale yellow-brown 17
16b. Hairs on the lower leaf surface curly, erect, reddish brown or straight, appressed, but very short, ca. 0.1 mm, whitish, free, not clumped 18
17a. Flowers and inflorescences distally densely pubescent ..... 5. *O. comata*
17b. Flowers glabrous; inflorescences very sparsely pubescent or glabrous ..... 7. *O. glabriflora*
18a. Indument on the twigs and lower leaf surface brown to reddish brown, tomentellous to tomentose, consisting of erect, curly hairs 19
18b. Indument on the twigs and lower leaf surface green to pale green, consisting of appressed, straight hairs ..... 9. *O. heterochroma*
19a. Pedicels distinct, as long as or longer than the flowers; basal pairs of secondary veins closer together than the distant ones .... 17. *O. pedicellata*
19b. Pedicels indistinct, shorter than the flowers; secondary veins evenly distributed 20
20a. Twigs sharply angular; leaves 15–23 cm, inflorescences to 23 cm long ..... 20. *O. terciopelo*
20b. Twigs terete or somewhat angular; leaves to 12 cm, inflorescences to 9 cm 21
21a. Young twigs and inflorescences dark brown puberulous, the surface partially visible; staminodia lacking ..... 12. *O. loxensis*
21b. Young twigs and inflorescences reddish brown tomentellous or tomentose, the surface completely covered; staminodia present 22
22a. Flowers ca. 4 mm diam.; leaves elliptic-obovate or obovate ..... 13. *O. micrantha*
22b. Flowers 6.5–9 mm diam.; leaves broadly to narrowly elliptic ..... 2. *O. arnottiana*

I. Ocotea Aubl., Hist. Pl. Guiane 2: 780–781, tab. 310. 1775. TYPE: *Ocotea guianensis* Aubl.

1. Ocotea andina van der Werff, sp. nov. TYPE: Peru. Pasco: Oxapampa, La Suiza Vieja, 10°28′14″S, 75°27′44″W, 20 Oct. 2009, *H. van der Werff, R. Vasquez & E. Machaca 22680* (holotype, MO-6351399; isotypes, B, F, HOXA not seen, K, MO-6351398, NY, P, US, USM not seen). Figure 1.

Ocoteae jelskii Mez similis, sed ab ea foliis fructibus cupulisque majoribus, petiolis longioribus et nervis secundariis 9 vel 10 (nec 7) recedit; ab *Ocotea benthamiana* Mez foliis angustioribus, tepalis extus sparsim pubescentibus et cupula simplicimarginata diversa est.

Trees to 25 m; twigs angular, 3–5 mm diam., solid, densely brown tomentose to moderately appressed pubescent, becoming almost glabrous in fruiting stage; terminal buds densely tomentose. Leaves 11–25 × 3.5–7.5 cm, alternate, elliptic to narrowly elliptic, chartaceous to coriaceous, base acute or obtuse, sometimes slightly reflexed at the base, margin plane, apex acute, upper surface of young leaves moderately pubescent with erect or ascending hairs, soon becoming glabrous, lower surface ferruginous tomentose or pubescent with appressed hairs, indument sparser with age and turning gray-purple in the fruiting stage; domatia absent; venation immersed on the upper surface, midrib and secondary veins raised or slightly raised, tertiary venation immersed on the lower surface, secondary veins 8 to 11 on each side; petioles 1.3–2 cm, strongly canaliculate, with the same indument as the twigs. Inflorescences 8–14 cm, in the axils of bracts or leaves, paniculate-cymose, densely tomentellous, tomentose or sparsely appressed pubescent. Flowers 3–4 mm diam., greenish yellow; pedicels 1–1.5 mm, pubescent to densely pubescent; tepals 1.5 × 1 mm, half erect, united at the base and falling as a unit in old flowers, sparsely pubescent on the inner surface, pubescent on the outer surface; stamens 9, all 4-locular, outer 6 stamens 1.2 mm, filament 0.2 mm, pubescent, inner 3 stamens 1.5 mm, filament pubescent, 0.5 mm; glands present at the base of the inner stamens; staminodia present, 0.5–1 mm, stipitiform, densely pubescent; pistil 2.5 mm, glabrous, style 1.5 mm; receptacle deep, (sparsely) pubescent inside. Fruits 3.3 × 2.3 cm, ellipsoid; cupule bowl-shaped, with a simple margin, 1.3 cm high, 2 cm diam., tepals deciduous in the fruiting stage.

Discussion. *Ocotea andina* is best recognized by its large, relatively narrow leaves with deeply canaliculate petioles and ferruginous pubescence. It can be confused with *O. jelskii*, but is a more robust species with larger leaves (11–25 × 3.5–7.5 cm vs. 5–12 × 2–4 cm), longer petioles (1.3–2 cm vs. 7–10 mm), larger fruits (3.3 × 2.3 cm vs. 1.7 × 1.2 cm) and cupules (1.3 cm high, 2 cm diam. vs. 7 mm high, 1 cm diam.), more secondary veins (eight to 11 on each side vs. ca. seven on each side), and the more pronounced venation. It can also be confused with *O. benthamiana*, but the latter species has wider leaves (6.5–10 cm vs. 3.5–7.5 cm), glabrous tepals (vs. pubescent on the outer and inner surfaces), and cupules with a double margin (vs. simple margin).

Figure 1. Holotype of *Ocotea andina* van der Werff (*H. van der Werff et al. 22680*, MO).

Ocotea andina has a wide range, from southern Ecuador to the Cusco Region in Peru. Leaf size and shape, cupule shape, and inflorescence size show little variation, but the species is less homogeneous in indument. Most flowering specimens have a tomentose-tomentellous indument on the leaves, but some have shorter, appressed pubescence; the outer surface of the tepals can range from pubescent to very sparsely pubescent and even the inside of the receptacle can vary from densely pubescent to

glabrous. The specimens with the least amount of pubescence are from the Kuelap Region in Amazonas, Peru, an area that is largely deforested; even there, one flowering collection had a glabrous receptacle (*van der Werff et al. 16855*, MO), one a sparsely pubescent receptacle (*Vasquez et al. 25423*, MO), and one a pubescent receptacle (*van der Werff et al. 14745*, MO). I prefer to recognize one species with variation in indument density instead of two taxa that differ only in density of pubescence.

The type collections of *Ocotea jelskii* were gathered in the Ayacucho area in central Peru, within the distribution range of *O. andina*. Because the differences between the two species are largely of scale, with *O. andina* being much coarser than the more delicate *O. jelskii*, I did consider including *O. andina* in *O. jelskii*. I decided against this option for two reasons: first, *O. jelskii* in this broad sense would be much more variable than any other *Ocotea* species in the Andes, and second, *O. andina* and *O. jelskii* are vegetatively very homogeneous species and can be separated from each other at first glance.

Two recent collections from Bolivia, *Fuentes et al. 15396* and *Fuentes et al. 7635A*, both at LPB and MO, resemble *Ocotea andina* closely. They differ, however, in a sparser pubescence (only partially covering the leaf surface) and a glaucous caste on the lower leaf surface; the flowering collection has a glabrous inside of the receptacle. Some, but not all, of the branches are hollow and inhabited by ants. These collections are provisionally identified as *Ocotea* aff. *andina*; their status may change when more collections are available.

Ocotea andina is known from the provinces of Loja and Zamora Chinchipe in southern Ecuador and from the departments of Amazonas, Cajamarca, San Martin, Pasco, and Cusco in Peru at altitudes from 2000 to 3000 m. Several collections have been previously identified as *Ocotea* aff. *aciphylla* (Nees) Mez (*Jørgensen et al. 1043*, MO, NY), as *O. benthamiana* (*van der Werff & Palacios 9245*, MO; *Young 1508*, MO), and as *O. jelskii* (*van der Werff et al. 14745*, MO; *van der Werff et al. 17719*, MO; *Vasquez et al. 25423*, MO; *Vasquez et al. 25434*, MO; *Vasquez et al. 25471*, MO), and duplicates may have been distributed under those names.

IUCN Red List category. *Ocotea andina* has been assessed as Near Threatened (NT), based on IUCN (2001) criteria.

Paratypes. ECUADOR. **Loja:** Cerro Uritusinga, Km. 18–20 of Loja–La Palma rd., 04°05′03″S, 79°13′40″W, *P. Jørgensen, C. Ulloa, S. Leon, H. Vargas & P. Lozano 1043* (MO, NY). **Zamora Chinchipe:** along new rd. Loja–Zamora, *H. van der Werff & W. Palacios 9245* (MO); Est. Cient. San Francisco, 03°58′S, 79°04′W, *J. Homeier 973* (F, MO, QCNE not seen), *J. Homeier 1474* (MO, US), *Cumbicus 552* (MO), *Cumbicus 1366* (MO). PERU. **Amazonas:** along rd. Tingo–Kuelap, Choctamal, 06°23′43″S, 77°57′53″W, *H. van der Werff, B. Gray, R. Vasquez & R. Rojas 14745* (MO); Luya Distr., entre María y Fortaleza Kuelap, 06°25′S, 77°55′W, *H. van der Werff, R. Vasquez, B. Gray & R. Rojas 16852* (CANB, HBG, MO, NY), *H. van der Werff, R. Vasquez, B. Gray & R. Rojas 16855* (CANB, F, HBG, MO); Luya Distr., Tingo, Kuelap, dentro de la fortaleza de Kuelap, *R. Vasquez, J. Campos & E. Teran 25423* (MO), *R. Vasquez, J. Campos & E. Teran 25434* (MO), *R. Vasquez, J. Campos & E. Teran 25471* (MO). **Cajamarca:** San Ignacio, Selva Andina, Camp. Zurita, 04°59′S, 78°55′W, *M. Huaman, J. Campos & W. Vargas 8* (F, K, MO, P), *M. Huaman & W. Vargas 20* (F, HBG, MO), *M. Huaman & W. Vargas 30* (B, MO); Prov. Cutervo, 4 km E of Huambo on Cutervo trail, 2800 m, 17 Dec. 1938, *Stork & Horton 10197* (UC). **Cusco:** Urubamba, Distr. Machu Picchu, 13°12′S, 72°33′W, *L. Valenzuela, G. Calatayud & I. Huamantupa 1764* (F, HBG, MO, NY); La Convención, Distr. Vilcabamba, Oyara, Cedropata, 13°04′39″S, 72°49′25″W, *L. Valenzuela, E. Succli, G. Calatayud, I. Huamantupa, N. Suarez & F. Zamora 8826* (MO). **Pasco:** Oxapampa, Distr. Chontabamba, carr. Chontabamba a la Suiza, 10°33′42″S, 75°27′23″W, *A. Monteagudo, A. Pena, R. Francis, C. Arias & C. Rojas 7591* (B, F, G, MO, US); Oxapampa, La Suiza Vieja, 10°33′S, 75°27′W, *H. van der Werff, R. Vasquez, B. Gray, R. Ortiz & N. Davila 17719* (MO). **San Martin:** Mariscal Cáceres, Rio Abiseo Natl. Park, 07°27′S, 77°21′W, *K. Young 1508* (MO).

2. Ocotea arnottiana (Nees) van der Werff, Ann. Missouri Bot. Gard. 76: 1175. 1989. Basionym: *Nectandra arnottiana* Nees, Syst. Laur. 289. 1836. *Nectandra laurel* Nees var. *arnottiana* (Nees) Meisn., Prodr. [DC.] 15: 147. 1864. TYPE: [Peru.] In Peruvia, *Matthews 1429* (holotype, E; isotypes, K not seen, P).

Pleurothyrium ferrugineum Meisn., Prodr. [DC.] 15: 169. 1864, nom. superfl. for *Ocotea arnottiana* (Nees) van der Werff. *Ocotea ferruginea* (Meisn.) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 265. 1889. TYPE: In Peruvia circa Jambrasbamba, *Matthews 1429* (holotype, K not seen).

Shrubs to 3 m, rarely a small tree, to 5 m; twigs angular, 4–5 mm diam., solid, densely ferruginous tomentellous, surface completely covered, indument wearing off with age; terminal buds densely ferruginous tomentellous. Leaves 3–10 × 1.7–7 cm, alternate, narrowly to broadly elliptic, firmly chartaceous to coriaceous, base acute to rounded, margin flat, apex acute to rounded, upper surface glabrous and often somewhat lustrous, lower surface densely ferruginous tomentellous, indument turning whitish with age, in some specimens very short; domatia absent; major veins immersed or slightly impressed, tertiary venation not visible on the upper surface, midrib raised, secondary veins and tertiary venation slightly raised or immersed on the lower surface,

secondary veins 6 to 8 on each side, petioles 3–9 mm, flat above, with a similar indument as the twigs. Inflorescences 2–10 cm, in the axils of leaves, ferruginous tomentellous, racemose and flowers clustered near the tip or paniculate and flowers clustered near the tip of first-order branches. Flowers 6.5–9 mm diam., yellow, yellow-green or cream; pedicels 2–3 mm, densely pubescent; tepals six, 2.7–3.2 mm, elliptic, spreading at maturity, becoming reflexed, pubescent on both surfaces; stamens 9, all 4-locular, outer 6 stamens 1.6–1.8 mm, anther glabrous, curved toward the center of the flower, as long as the sparsely pubescent filament, inner 3 stamens 1.8–2 mm, straight, anther about as long as the filament; glands present at the base of the inner stamens; staminodia present, 0.7 mm, stipitiform, glabrous or with a few hairs; pistil 1.5–2 mm, glabrous, style as long as the ovary; receptacle deep, glabrous inside. Fruits 1.7 × 1.2 cm, ellipsoid; cupule shallow, 1.2 cm diam., initially pubescent, becoming glabrous with age, tepals persisting as lobes on the margin of the cupule.

Discussion. *Ocotea arnottiana* can be recognized by inflorescences with flowers clustered or racemose toward the tip of the inflorescence or toward the tips of the first-order branches, its flowers with spreading tepals, relatively inconspicuous tertiary venation, and persistent tepals on the cupule. It is a frequently collected shrub found on poor, sandstone-derived soils. *Ocotea pajonalis* van der Werff, another shrubby species from Peru, occurs in a similar sandstone habitat but differs in having the pubescent receptacle on the inner surface (vs. glabrous inside), smaller flowers (5 mm vs. 6.5–9 mm diam.), deciduous tepals in fruit, larger fruits (2.8 × 2.4 cm vs. 1.7 × 1.2 cm), and more pronounced tertiary venation.

Morphologically, *Ocotea arnottiana* is quite variable. Its leaves vary in shape from narrowly elliptic, 9.5 × 2.5 cm (*van der Werff et al. 14932*, MO), to broadly elliptic, 10 × 7 cm (*Jelski 193*, MO), and size; *van der Werff et al. 23071* has leaves to 3.5 × 2.5 cm. Most specimens have a ferruginous indument that sometimes becomes pale brown with age, but a few collections (*Hutchison & Wright 5535*, F, MO, US; *Mostacero et al. 1603*, MO; *Smith & Cabanillas 7191*, MO; and *Wurdack 1278*, F, US) have a shorter, pale brown pubescence on all leaves that nevertheless covers the surface completely.

Ocotea arnottiana is known from northern Peru, department of Amazonas, Chachapoyas Province, and in the adjacent department of Cajamarca, Cutervo, and along the Chachapoyas–Celendin road between Leymebamba and Calla-Calla, and from central Peru, department of Pasco, in the Cordillera de Yanachaga at altitudes between 2000 and 3100 m. Flowers have been collected in every month except August and December.

Meissner (1864) treated *Nectandra arnottiana* Nees as *N. laurel* Klotzsch ex Nees var. *arnottiana* (Nees) Meisn.; he noted that he had not seen the plant, but that it was scarcely different from *N. laurel*, based on the description. Meissner did see a duplicate of *Matthews 1429*, the type collection of *N. arnottiana*, in K and described it as *Pleurothyrium ferrugineum*, a superfluous name because he should have used the epithet *arnottianum*. Rohwer (1986) placed this species (as *Ocotea ferruginea* [Meisn.] Mez) in his *O. aciphylla* group, but with hesitation. He saw only the type, a flowering specimen. I exclude it from the *O. aciphylla* group because of the persistent tepals in the fruiting stage and the flat (not canaliculate) petioles.

IUCN Red List category. This locally common species is assessed as Near Threatened (NT), based on IUCN (2001) criteria.

Selected specimens seen. PERU. **Amazonas:** Chachapoyas, *van der Werff et al. 16884* (MO); Chachapoyas–Celendin rd., betw. Leymebamba & Calla-Calla, *Smith & Cabanillas 7191* (MO). **Cajamarca:** Cutervo Prov., rd. from Cutervo to Socota, *Castro et al. 19564* (MO). **Pasco:** Oxapampa Prov. Cerro Pajonal, 29 km from Oxapampa, *Smith & Foster 2519* (F, MO); Oxapampa Prov., Milpo, *van der Werff et al. 23071* (MO).

3. Ocotea benthamiana Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 263. 1889. *Nectandra crassifolia* Benth., Pl. Hartw. 253. 1846, non *Ocotea crassifolia* (Nees) Mez, Jahrb. Königl. Bot. Gart. Berlin. 5: 336. 1889. TYPE: Ecuador. Pichincha: in loco Chichipunta dicto, *K. T. Hartweg 1392* (holotype, K not seen; isotypes, B, BM not seen, G not seen, P not seen).

Trees or shrubs to 15 m; twigs angular, 4–8 mm diam., solid, ferruginous tomentose, terminal buds densely tomentose. Leaves 12–27 × 6.5–10 cm, alternate, elliptic to broadly elliptic, subcoriaceous, base obtuse to acute, margin plane, apex acute, upper surface sparsely pubescent when young, soon becoming glabrous, lower surface ferruginous tomentose, the surface completely covered by the indument, color of indument fading with age; domatia absent; venation immersed on the upper surface, midrib and secondary veins prominently raised on the lower surface, tertiary venation less so, scalariform, secondary veins 6 to 9 on each side; petioles 1.7–2.8 cm, strongly canaliculate. Inflorescences 5–14 cm, ferruginous tomentose, paniculate, the first-order branches

with 1 or 3 cymes. Flowers 6.5–9 mm diam., white or yellowish white, fragrant, subsessile; hypanthium densely pubescent and gradually narrowed in the short pedicel; tepals six, 3.5 × 2 mm, spreading to half erect, outer surface glabrous or with a few hairs near the base, inner surface glabrous or sparsely pubescent, margin papillose; stamens 9, all 4-locular, outer 6 stamens 2 mm, filament 0.5 mm, pubescent, inner 3 stamens 2–2.25 mm, filament pubescent; glands present at the base of the inner stamens; staminodia present, 1.2 mm, stipitiform, pubescent; pistil 3.5 mm, glabrous, ovary gradually narrowed in the style, stigma platelike; receptacle deep, densely pubescent inside. Fruits to 4.6 × 3 cm, ellipsoid; cupule deep, 2.5 cm high, to 3.2 cm wide, tepals deciduous in the fruiting stage.

Discussion. Until recently, this species was known only from the type collection, with fruits. Rohwer (1986) placed it therefore among species of unknown generic affinity. Collections with flowers date from 1992 and were made in the Bosque Protectora Maquipucuna, close to the type locality in Ecuador. *Ocotea benthamiana* is a very distinctive species, with large ferruginous pubescent leaves, long canaliculate petioles, large flowers with largely glabrous petals and large, slightly double-margined cupules. Although a few other species (*O. andina*, *O. terciopelo*) have large ferruginous pubescent leaves, none have large flowers or cupules. *Ocotea benthamiana* is known from the province of Carchi in northern Ecuador to the Amazonas and Cajamarca departments in northern Peru at altitudes from 2100 to 2900 m. Flowering and fruiting collections have been made from July to February; no fertile collections are known from February to July.

IUCN Red List category. *Ocotea benthamiana* has been assessed as Near Threatened (NT), based on IUCN (2001) criteria.

Selected specimens seen. ECUADOR. **Carchi:** Cerro Golondrinas, 24 July 1994, *Boyle et al. 3418* (MO). **Morona Santiago:** Vía Gualaceo–Plan de Milagro, 1 Feb. 1989, *Palacios & van der Werff 3711* (MO). **Napo:** Quijos, Res. Ecol. Antisana, 3–5 Jan. 1999, *Vargas & Narváez 3352* (MO). **Pichincha:** Parroquia Nanegal, Bosque Protectora Maquipucuna, 16 July 1992, *Webster et al. 29471* (MO). **Zamora Chinchipe:** Parque Nac. Podocarpus, new rd. Loja–Zamora, 26 Sep. 1989, *Madsen 86179* (MO). PERU. **Cajamarca:** San Ignacio, Selva Andina, Trayecto a Cerro Bolo, 13 Oct. 2000, *Huamán et al. 18* (MO); Amazonas, Luya Prov., Distr. Camporredondo, entre Pájaco Tigre y la Palma, 9 Dec. 1996, *Campos et al. 3143* (MO).

4. Ocotea cardinalis Mez, Repert. Spec. Nov. Regni Veg. 3: 69, 1906. TYPE. Peru. Huánuco: Prov. Huamalies, Berge südwestlich von Monzon, *A. Weberbauer 3545* (holotype, B).

Shrub or trees to 20 m; twigs angular, 4–5 mm diam., densely ferruginous tomentellous, becoming glabrescent with age; terminal buds densely ferruginous tomentellous. Leaves 8–17 × 3.5–7 cm, alternate, elliptic, firmly chartaceous, base decurrent on the petiole, revolute, margin plane, apex acute or obtuse, upper surface with a similar indument, but less dense and the surface partially visible, soon becoming glabrous, lower surface densely pubescent, hairs erect, twisted and covering the surface completely; domatia absent; midrib and secondary veins immersed or slightly impressed, tertiary veins immersed and scarcely visible on the upper surface; midrib and secondary veins raised, tertiary veins scalariform, faintly raised on the lower surface, secondary veins 6 to 9 on each side of the lamina; petioles ca. 8 mm or winged almost to the base, flat above, densely tomentellous to almost glabrous. Inflorescences 6–20 cm, densely rufous tomentellous, paniculate-cymose, in axils of leaves. Flowers yellow or green, ca. 5 mm diam.; pedicels 2.5 mm, densely ferruginous pubescent, receptacle densely ferruginous pubescent outside, tepals six, 2.2 mm, spreading, densely tomentellous on the outer surface, sparsely pubescent on the inner surface, stamens 9, all 4-locular, 1 mm, glabrous, filaments short, half as long as the anther; glands present at the base of the inner stamens; staminodia present, 0.3 mm, the tip enlarged, sagittate; pistil 2 mm, glabrous; receptacle cup-shaped, glabrous inside. Immature fruits largely enclosed in the young cupule, this 7 × 7 mm, mature fruits not seen.

Discussion. *Ocotea cardinalis* is easily recognized by the combination of its decurrent, revolute leaf bases, the dense ferruginous tomentellous indument, and the poorly visible, immersed tertiary venation. Known from Colombia, Ecuador, and Peru, *O. infrafoveolata* van der Werff also has leaves with a decurrent, revolute base, but differs in the raised, conspicuously reticulate venation on the lower leaf surface, and the leaves are stiffer and the flowers larger (to 10 mm diam.) than in *O. cardinalis*. In addition, flowers in *O. infrafoveolata* are sessile or nearly so, whereas pedicels are distinct, as long as the flowers in *O. cardinalis*. The type collection of *O. cardinalis*, *Weberbauer 3545*, is largely in bud and has very few open flowers. I did not dissect a flower of the type and the floral description is based on the recent collection with flowers (*Sanchez Vega 6007*, MO). The recent

collections have larger leaves than the type (to 10 cm in the type, to 17 cm in the recent collections), and the inflorescence of *Sanchez Vega et al. 6007* is longer than the type (10 cm vs. 20 cm). The differences between the type collection and the recent collections are relatively small and do not warrant recognition of two taxa. *Ocotea cardinalis* is known from three collections in central and northern Peru, at altitudes between 2400 and 2500 m; the two flowering collections were made in August and November.

IUCN Red List category. This species has been assessed as Data Deficient (DD), based on IUCN (2001) criteria.

Additional specimens studied. PERU. **Cajamarca:** Prov. Cutervo, Km. 10 desde San Andrés hacia Sócota, 19 Apr. 1988, 2500 m, *Diaz & Baldeon 2799* (MO); entre San Andrés y El Suro, 4 Nov. 1991, 2400 m, *Sanchez Vega et al. 6007* (MO).

5. Ocotea comata van der Werff, sp. nov. TYPE: Bolivia. La Paz: Franz Tamayo, Parque Nacional Madidi, Sector Santa Ana, por el antiguo camino Pelechuco–Apolo, 14°46′30″S, 68°58′13″W, 2300 m, 25 June 2009, *A. Fuentes, J. Salas & R. Huasurco 14843* (holotype, LPB; isotypes, B, BOLV, MO-6351387, USZ). Figure 2.

Ocoteae glabriflorae van der Werff similis, sed ab ea floribus inflorescentiisque pubescentibus diversa.

Trees to 15 m; twigs angular, 5–7 mm diam., densely pubescent with appressed or ascending hairs, the surface completely covered on young shoots but the indument wearing off on older twigs; terminal buds densely pubescent. Leaves 6–14 × 3–5 cm, alternate, elliptic, stiffly chartaceous, base acute, margin flat, apex acute, upper surface glabrous or with a few appressed hairs, mostly along the midrib, lower surface densely appressed pubescent, hairs to 1 mm, often the tips of neighboring hairs twisted together, indument pale yellow-brown, wearing off with age; domatia absent; midrib and secondary veins slightly impressed, tertiary venation forming a very fine reticulum, midrib and secondary veins raised, tertiary venation slightly raised, a fine reticulum not visible on the lower surface, secondary veins 5 to 8 on each side; petioles 5–8 mm, appressed pubescent, flat or shallowly canaliculate above. Inflorescences to 20 cm, in the axils of leaves or bracts near the tips of the branches, paniculate-cymose, basally sparsely pubescent, becoming densely pubescent toward the flower-bearing stems; pedicels and base of the flowers densely pubescent, surface completely covered. Flowers 5 mm diam., white; pedicel ca. 1 mm, densely pubescent; receptacle densely pubescent outside, tepals six, 2–2.4 mm, pubescent on both surfaces, spreading at maturity; stamens 9, all 4-locular, 1 mm, filament very short, pubescent, anthers dorsally somewhat pubescent; glands 2 at the base of inner stamens; staminodia present, ca. 0.5 mm, stipitiform, with a few hairs at the base, otherwise glabrous; receptacle deep, glabrous inside; pistil 2 mm, glabrous, the style as long as the ovary. Fruits 1.4 × 1.6 cm (immature), broadly ellipsoid; cupule 1.3 cm high, 2 cm diam., smooth, with a single margin, tepals deciduous in the fruiting stage.

Discussion. The dense pubescence, consisting of long, appressed to ascending hairs, is indicative for *Ocotea comata*. Its relationships with other *Ocotea* species are not clear. The short, flat petioles, small stamens, and even distribution of the secondary veins make a placement in the *O. aciphylla* group unlikely. One other species, *O. glabriflora* van der Werff, has a similar indument, but differs in its glabrous flowers and nearly glabrous inflorescences. The tepals are persistent on young fruits of *O. comata*, but fall off when the young fruits, still enclosed in the receptacle, are about 5 mm diam. The indument is deciduous with age, and leaves of fruiting specimens are at best sparsely pubescent. However, traces of the indument consisting of long hairs persist along the midrib. *Ocotea comata* is known only from the Madidi Region in Bolivia and occurs between 2300 and 2700 m altitude. The single flowering collection was made in June and also includes fruits. A collection with immature fruits was made in March.

IUCN Red List category. *Ocotea comata* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Paratypes. BOLIVIA. **La Paz:** Franz Tamayo, Parque Nacional Madidi, 14°36′40″S, 68°57′09″W, 2400 m, 26 June 2005, *A. Fuentes, E. Cuevas, R. Cuevas & Moises 8787* (MO); Muñecas. Monte Puncu, Machayani, entre Camata y Cuibaja, 15°18′35″S, 68°46′00″W, 2680 m, 18 May 2006, *A. Fuentes, C. Monroy & E. Monroy 10768* (MO, NY), 20 May 2006, *A. Fuentes, A. Poma & E. Monroy 10885* (HBG, MO); Franz Tamayo, Parque Nacional Madidi, entre Mojos y Queara, 14°37′06″S, 68°57′07″W, 2342 m, 3 Mar. 2008, *A. Fuentes, R. Lipa & R. Machaca 12246* (B, MO); Parque Nacional Madidi, sector Tocoaque (entre Keara y Mojos), 14°37′03″S, 68°57′10″W, 2380 m, 2 Oct. 2009, *A. Fuentes, D. Alanes & M. Chambi 15489* (MO, P); Nor Yungas, Huancane entrando hacia San Isidro, 2300 m, 25 Sep. 1994, *S. Beck 22268* (MO).

6. Ocotea gentryi van der Werff, sp. nov. TYPE: Colombia. Boyacá: Cerca de Arcabuco, 2750 m, 25 Nov. 1940, *E. Pérez Arbeláez & J. Cuatrecasas 8179* (holotype, US-1796090; isotype, COL). Figure 3.

Figure 2. Isotype of *Ocotea comata* van der Werff (*A. Fuentes et al. 14843*, MO).

Ocoteae benthamianae Mez foliis subtus indumento obtectis, tepalis extus pro parte majore glabris similis, sed ab ea foliis minoribus, petiolis brevioribus et indumento foliorum cinnamomeo-pubescenti (nec ferrugineo-pubescenti) recedit.

Trees to 25 m; twigs terete, 3–4 mm diam., densely brown pubescent, the hairs short, ascending to appressed, the indument covering the surface completely; terminal buds densely pubescent. Leaves

4–10 × 2–4.5 cm, alternate, elliptic, coriaceous, base acute to obtuse, flat or slightly revolute, margin plane, apex bluntly acute or obtuse, upper surface glabrous, lower surface brown tomentellous, surface completely covered by the indument; domatia absent; venation immersed on the upper surface, midrib and secondary veins raised on the lower surface, tertiary venation inconspicuous, immersed, secondary veins 5 to 7 on each side; petioles 5–8 mm, flat or weakly canaliculate above, pubescent. Inflorescences 4–8 cm, predominantly in the axils of bracts near the tips of the twigs, less frequently in axils of leaves, paniculate-cymose, densely pubescent; pedicels 2 mm, densely pubescent. Flowers 7–8 mm diam., white or creamy white; pedicels ca. 1 mm, pubescent; tepals six, 2.5–3 × 2 mm, ovate, half erect to spreading, glabrous outside or with some hairs near the base, pubescent on the inner surface, margin papillose; stamens 9, all 4-locular, 1.5 mm, filament 0.5 mm, pubescent, anther 1 mm, glabrous; glands at the base of the inner stamens, 0.5 mm diam.; staminodia present, 0.75 mm, stipitiform, lower half densely pubescent, tip glabrous; pistil glabrous, 2.5 mm, style about half as long as the ovary; receptacle deep, densely pubescent inside and outside. Fruits ellipsoid, 12 × 8 mm; cupule cup-shaped, 8 mm high, 1.3 cm diam., with a simple margin, tepals deciduous in the fruiting stage.

Discussion. The most striking character of *Ocotea gentryi* is the nearly glabrous tepals, which contrast with the densely pubescent outer surface of the receptacle. This character occurs also in *O. benthamiana*, a much coarser species with larger leaves (12–27 × 6.5–10 cm vs. 4–10 × 2–4.5 cm) and longer petioles (1.7–2.8 cm vs. 5–8 mm). *Ocotea benthamiana* also has ferruginous pubescent lower leaf surfaces, whereas the leaf indument of *O. gentryi* is less reddish brown. In leaf shape and indument, *O. gentryi* resembles *O. jelskii* strongly, but the latter species has a similar density of indument on the tepals and receptacle and has smaller tepals (1–1.2 mm vs. 2.5–3 mm). The distribution of the two species is also different: *O. gentryi* is known from the mountains in eastern Colombia and adjacent Venezuela, whereas *O. jelskii* is known only from Peru.

Of the four collections with flowers, the type collection has the best developed flowers and the description of the flowers is based on this collection. The other three collections are mostly in bud, but the few open flowers are smaller than those of the type collection, seem to have staminodia instead of stamens (rarely do a few of those have open locelli, but without visible pollen grains), and have a glabrous interior to the receptacle. This suggests that *O. gentryi* may have individuals with perfect flowers and with pistillate flowers, similar to what is found in *O. infrafoveolata*. No stamens or staminodia were found on the cupules. *Ocotea gentryi* is known from the upper slopes of the Sierra Nevada de Santa Marta and the Serrania de Perija in northeastern Colombia and adjacent Venezuela at altitudes from 2600 to 2900 m. Three of the flowering collections were made in March, July, and November; the fourth has no collection date.

The nomenclatural history associated with this species is confusing. Nees (1848) described *Nectandra* var. *diversifolia* and cited only one collection (*Karsten 92*). Meissner raised this variety to species as *Mespilodaphne baccans*, cited Nees' name in the synonymy, and listed three collections: *Karsten 92*, *Linden 213*, and *Linden 715*. Mez (1889) treated the two Linden collections and *Karsten 92* as different species; *Karsten 92* became the type of *N. baccans* (Meisn.) Mez and Mez created a new name, *Ocotea discolor* Mez, for the two Linden collections. However, *O. discolor* Mez is a later homonym of *O. discolor* Kunth, and therefore, the name *O. gentryi* is here proposed for the illegitimate name *O. discolor* Mez.

Etymology. *Ocotea gentryi* is dedicated to the late Al Gentry (1945–1993), friend, colleague, and botanist par excellence.

IUCN Red List category. *Ocotea gentryi* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Paratypes. COLOMBIA. **Cesar:** Serrania de Perija, E of Manaure (fl.), 2880 m, 11 Mar. 1993, 10°30′N, 72°55′W, *A. Gentry & H. Cuadros 79199* (MO). **Cundinamarca:** Zipaquira (fl.), 1943, *Fathers Huertos & Camargo 827* (US). **Guajira:** Cerro del Espejo, Serrania de Perija (st.), 2560 m, 28 Apr. 1987, 10°28′N, 72°50′W, *A. Gentry & H. Cuadros 57186* (MO); prov. de Pamplona, 9200 ft., Nov–Dec. 1842 (fl.), *Linden 715* (P); Nouvelle Grenada, *M. Triana 1022* (MO, P). **Magdalena:** Cerro Kennedy, Sierra Nevada de Santa Marta (st.), 2600 m, 14 Jan. 1989, 11°05′N, 74°01′W, *A. Gentry & H. Cuadros 64686* (MO). VENEZUELA. **Zulia:** Distr. Perija, headwaters of Rio Guasare, 2700 m, 20–23 July 1974 (fl.), 10°23′07″N, 72°52′45″W, *C. Wood & P. Berry 112* (MO).

7. Ocotea glabriflora van der Werff, sp. nov. TYPE: Peru. Cusco: La Convención, Distr. Quellouno, Lacco, Vellavista, 12°37′29″S, 72°14′54″W, 22 Aug. 2007, 2757 m, *L. Valenzuela, A. Carazas, B. Rado & S. Flores 10133* (holotype, MO-6351388; isotypes, B, NY, P). Figure 4.

Ocoteae comatae van der Werff similis, sed ab ea floribus glabris et inflorescentiis glabris vel paucis trichomatibus vestitis recedit.

Trees to 18 m; twigs angular, 5 mm diam., solid, densely appressed pubescent, the surface completely

Figure 3. Holotype of *Ocotea gentryi* van der Werff (*E. Pérez Arbeláez & J. Cuatrecasas 8179*, US).

covered, the indument floccose, hairs tufted; terminal buds densely appressed pubescent. Leaves 7–12 × 3–4.5 cm, alternate, elliptic or narrowly elliptic, firmly chartaceous, base acute, margin flat, apex acute, upper surface with some appressed, straight hairs when young, soon becoming glabrous, lower surface densely pubescent with appressed hairs, surface completely or largely covered, hairs tufted, floccose; domatia absent; midrib and secondary veins slightly impressed, ultimate venation very finely reticulate on the upper surface,

midrib and secondary veins raised, tertiary venation immersed and scarcely visible, fine reticulum not visible on the lower surface, secondary veins 6 to 9 on each side; petioles 5–10 mm, with a similar indument as the twigs, slightly canaliculate. Inflorescences 7–12 cm, paniculate-cymose, very sparsely pubescent to glabrous, in the axils of foliage leaves or deciduous bracts. Flowers glabrous, 6 mm diam., pink or reddish white, buds reddish; pedicels 1–1.5 mm, shorter than the flowers, glabrous; tepals 6, spreading at maturity, glabrous outside, densely pubescent inside, 2 mm; stamens 9, all 4-locular, 1.2 mm, filament pubescent, ca. 0.2 mm, the anthers basally with some hairs, otherwise glabrous; glands 2, globose, at the base of inner 3 stamens; staminodia present, 1 mm, stipitiform, pubescent; pistil 3 mm, cylindrical, ovary gradually narrowed in the style; receptacle deep, glabrous on inner and outer surface. Fruits and cupule unknown.

Discussion. Described from Cusco, Peru, *Ocotea glabriflora* is very similar to *O. comata* in indument, leaf shape, venation, and stamen characters, and *O. comata* is known from the Madidi Region in Bolivia. The two species differ in the pubescence: *O. glabriflora* has glabrous flowers and very sparsely pubescent inflorescences, whereas *O. comata* has a rather dense pubescence on its inflorescences and flowers. Relationships with other *Ocotea* species are not obvious. As in *O. comata*, the indument on the leaves loses its density with age and the lower leaf surface of older leaves is not fully covered by the pubescence.

IUCN Red List category. *Ocotea glabriflora* has been assessed as Data Deficient (DD), based on IUCN (2001) criteria.

Paratype. PERU. **Cusco:** La Convención, Distr. Quellouno, Lacca, Vellavista, 12°34′30″S, 72°10′48″W, 23 Aug. 2007, 2748 m, *L. Valenzuela, A. Carazas, B. Rado & S. Flores 10161* (F, HBG, MO, US).

8. Ocotea guaramacalensis van der Werff, sp. nov. TYPE: Venezuela. Trujillo: Dpto. Boconó, Cerro Guaramacal, 5 July 1994, 2600 m, *B. Stergios, M. Nino & A. Licata 16107* (holotype, MO-6351385; isotypes, B, F, NY, P, PORT not seen, US). Figure 5.

Ocoteae arnottianae (Nees) van der Werff similis, sed ab ea floribus minoribus (ca. 5 vs. 6.5–9 mm diam.), receptaculo intus pubescenti et tepalis deciduis recedit.

Trees to 35 m; twigs terete, 3–5 mm diam., solid, densely and minutely appressed pubescent, indument covering the twigs entirely; terminal buds densely appressed pubescent, hairs often pale brown. Leaves 3.5–7 × 2–4 cm, alternate, broadly elliptic to slightly obovate, coriaceous, base acute, angustate or obtuse, margin plane, apex obtuse sometimes with a small acumen, upper surface glabrous, lower surface covered by a dense, appressed, pale brown indument, hairs very short, matted, indument contrasting with the darker veins; domatia absent; venation immersed on the upper surface, even the secondary veins scarcely visible, midrib and secondary veins slightly raised on the lower surface, tertiary venation immersed, secondary veins 7 to 9 on each side, somewhat loop-connected distally; petioles 4–6 mm, flat above, with a similar indument as the twigs. Inflorescences 5–8 cm, mostly in the axils of bracts at the base of seasonal growth, occasionally in the axils of leaves, paniculate-cymose, densely tomentellous. Flowers 5 mm diam., yellow-green; pedicels to 1.5 mm, densely tomentellous; tepals six, 1.5 × 1 mm, spreading, pubescent on the outer surface and inner surface, papillose toward the margin; stamens 9, all 4-locular, outer 6 stamens ca. 1 mm, glabrous or with a few hairs on the very short filament, inner 3 stamens ca. 1 mm, glands 2 at the base of the inner stamens; staminodia present, 0.5 mm, stipitiform, with a few hairs; pistil 1.7 mm, glabrous, style about as long as the ovary; receptacle deep, densely pubescent inside. Infructescences to 12 cm; old cupules cup-shaped, with a single margin, 1.2 cm high, 1.5 cm diam.; fruit not seen.

Discussion. *Ocotea guaramacalensis* has no close relatives among the Andean species of *Ocotea*. The pale brown pubescence of the leaves consisting of very short hairs is found in a few collections of *O. arnottiana*, but that species has larger flowers (6.5–9 mm vs. 5 mm diam.), the inside of the receptacle is glabrous, and the tepals are persistent on the cupule. The habit is also different: *O. guaramacalensis* grows into tall trees, to 35 m, whereas *O. arnottiana* is a shrubby species, usually 2–3 m tall, only rarely to 5 m. The pale brown lamina contrasting with the darker veins has not been found in other species. The flowers and cupules are rather nondescript. This species has been collected with flowers in July; the altitudinal range is from 2400 to 2700 m.

There is a second species of *Ocotea* with the lower leaf surface completely covered by the pubescence in the Venezuelan state of Trujillo. It has a rusty brown, tomentose indument, small (to 5 × 2 cm) leaves with the venation prominently raised on the lower leaf surface, and a platelike cupule. In leaf size and shape it resembles *O. loxensis* van der Werff, a species known only from southern Ecuador, which differs in a more prominently raised tertiary venation on the upper leaf surface. The single collection, *R. F. Smith 9713* (MO), probably represents an undescribed species, but flowering material is needed for a description.

Figure 4. Holotype of *Ocotea glabriflora* van der Werff (*L. Valenzuela et al. 10133*, MO).

IUCN Red List category. *Ocotea guaramacalensis* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Paratypes. VENEZUELA. **Trujillo:** Cerro Guaramacal, 2700 m, 5 July 1994, *B. Stergios, M. Nino & A. Licata 16113* (HBG, MO, NY, PORT not seen, US); Parque Nac. Guaramacal, 2400 m, 1–3 July 1995, 09°14′48″N, 70°12′15″W, *N. Cuello 1137* (PORT not seen, US).

9. Ocotea heterochroma Mez & Sodiro, Bull. Herb. Boissier, sér. 2, 5: 239, 1905. TYPE: Ecuador.

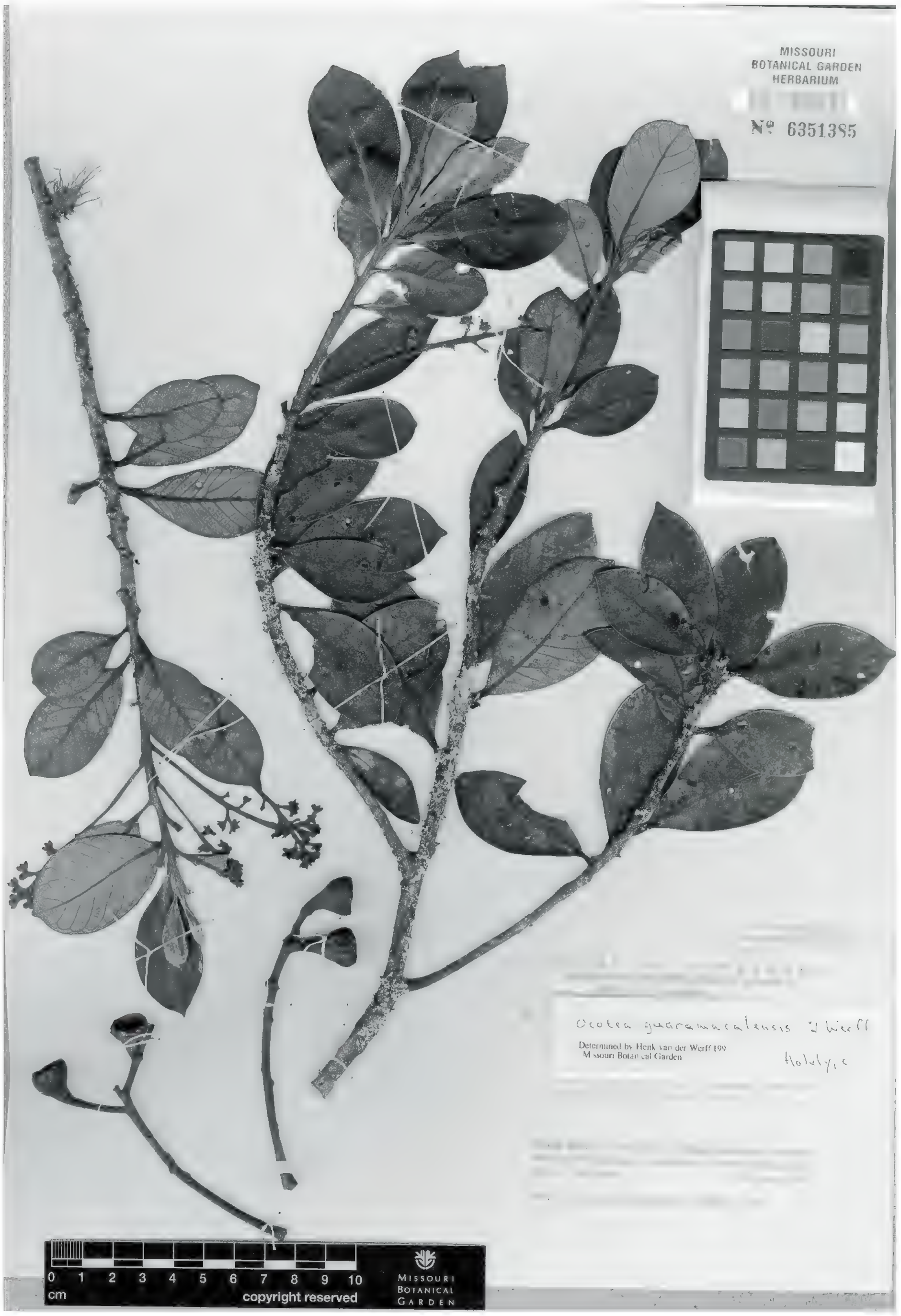

Figure 5. Holotype of *Ocotea guaramacalensis* van der Werff (*B. Stergios et al. 16107*, MO).

In silvis subandinis occidentalibus vulcani Tungurahua, Aug. 1901, *Sodiro 143/6b* (holotype, B).

Ocotea otuzcensis O. C. Schmidt, Repert. Spec. Nov. Regni Veg. 31: 183. 1933, syn. nov. TYPE: Peru. Libertad, Otuzco, über Succhabamba, 2700 m, 29 June 1914, *Weberbauer 6998* (holotype, B).

Trees to 30 m, sometimes flowering at 6 m; twigs angular to terete, 3–5 m diam., moderately to densely appressed to ascending pubescent, hairs inconspic-

uous, straight, pale green, glabrescent with age; terminal buds densely pubescent. Leaves 7–14 × 4–7.5 cm, alternate, narrowly to broadly elliptic, firmly chartaceous to coriaceous, base obtuse to acute, margin flat, apex rounded to acute, upper surface glabrous, lower surface sparsely to densely pubescent, hairs inconspicuous, colorless, appressed, lower surface partly or entirely covered; domatia absent; venation slightly raised on the lower surface, midrib and secondary veins immersed or slightly impressed, tertiary venation immersed and scarcely visible on the upper surface, secondary veins 6 to 8 on each side; petioles 5–13 mm, canaliculate, with a similar indument as the twigs. Inflorescences 5–14 cm, in the axils of leaves, paniculate-cymose, densely to moderately pubescent, the hairs appressed to erect. Flowers 6–8 mm diam., greenish yellow; pedicels 2–3 mm densely pubescent; tepals six, 2–3 mm, spreading at maturity, sparsely to densely pubescent on the outer surface, inner surface with some hairs near the base and fine hairs or papillae near the tip, otherwise glabrous; stamens 9, all 4-locular, filaments with a few hairs, anthers glabrous, outer 6 stamens 1 mm, filaments half as long as the anthers, anthers curved inward, inner 3 stamens straight, 1.6 mm, filament slightly shorter than the anthers; glands globose at the base of the inner stamens; staminodia present, ca. 1 mm, with a triangular tip, glabrous; receptacle deep, glabrous inside, pubescent outside, pistil 2 mm, glabrous, style as long as the ovary. Fruits ca. 3.5 × 2.4 cm; cupule 1.7 cm high, 3.5 cm diam., with an inconspicuous double margin, the outer rim a little longer than the inner one, tepals deciduous in the fruiting stage.

Discussion. *Ocotea heterochroma* is best recognized by the combination of pale, appressed hairs on the lower leaf surface, flowers with spreading tepals, those largely glabrous on the inner surface and deep cupules with a double margin. The density of the pubescence is variable; in some specimens the lower leaf surface is entirely covered, but in other specimens the surface is partly visible. The description of the flowers is based on recent collections. The holotype has few flowers and these are not in good condition. I decided not to dissect flowers of the type. Rohwer (1986) analyzed flowers of all *Ocotea* types and attached small drawings of his observations to the type specimens. He reported that the dissected flower was abnormal and that the receptacle had appressed hairs on the inner surface. I dissected flowers from seven collections (from Colombia and three localities in Ecuador); of those, six had a completely glabrous interior of the receptacle, although one collection, *Caranqui 1632* (MO), from Penipe, relatively close to the type locality in Ecuador, had a few appressed hairs in the receptacle. Because in all other characters the recent collections are a good match for the type, I decided to overlook the observation of the pubescent receptacle of the single dissected (and abnormal) flower of the type and treat the recent collections with a glabrous receptacle as *O. heterochroma*. Weberbauer (in sched.) noted that this species has excellent-quality wood (ligno optimo) and listed as common name "Canelo." Several recent collections were made along the road Papallacta–Baeza in Ecuador; in that region the wood is considered to be of good quality and is much used; an infusion of the leaves is used for flavoring beverages and for bathing sick children. The common name for this species is still Canelo (*Palacios & van der Werff 3699*, MO). The label of *Tipaz 1* (MO), from Montúfar Canton in Carchi Province, states that the wood is used for "tablas, tablones y para carpintería." Cupules of this species are relatively large; one collection, *Jaramillo et al. 8984* (MO), has immature cupules (with the young fruit completely enclosed) 2 cm high and 2.2 cm in diameter.

The type collection of *Ocotea otuzcensis* has larger and wider leaves than *O. heterochroma* and has somewhat larger inflorescences, but these differences are not sufficient for the recognition of two species, and the name is synonymized. I have not seen recent collections of this species from the department of La Libertad in Peru or from Peru in general.

Several collections of *Ocotea heterochroma* (*Tipaz 1*, *Palacios & van der Werff 3661*, *3669*, *van der Werff & Palacios 10595*, *van der Werff & Gray 13363*) have been previously identified as *O. stuebelii* Mez and duplicates may have been distributed under that name. This species occurs between 2600 and 3500 m; flowering specimens in the northern part of the range have been collected from January to March, whereas south of Quito most flowering collections (including the types of *O. heterochroma* and *O. otuzcensis*) were made in July and August.

IUCN Red List category. *Ocotea heterochroma* has been assessed as Near Threatened (NT), based on IUCN (2001) criteria.

Selected specimens seen. COLOMBIA. **Cauca:** Macizo Colombiano, páramo de las Papas, entre el Boquerón y la Hoyola, 3200–3500 m, 27 July 1958, *Idrobo et al. 3561* (P); Cundinamarca, Région de Sumapaz, 3000–3300 m, 13–15 Jan. 1997, *Betancur et al. 6914* (MO). **Valle del Cauca:** Mun. Tuluá, Corr. Santa Lucía, 2800 m, 22 Sep. 1984, *Devia 705* (MO). ECUADOR. **Azuay:** Carretera Cuenca–Bosque de Mozan, 3000–3200 m, 17 Aug. 1987, *Zak et al. 2473* (MO). **Carchi:** ca. 1/2 hr. E of Huaca, past Colonia Huaceña, 3100–3200 m, 18 Feb. 1989, *van der Werff & Palacios 10595* (MO). **Chimborazo:** Palitagua, faldas occidentales del Tungurahua, 2600 m, 10 Aug. 1986,

Jaramillo et al. 8984 (MO). **Napo:** Vía Quito-Baeza, Est. Petrolera de Papallacta, 2900 m, 26 Jan. 1989, *Palacios & van der Werff 3699* (MO). PERU. **La Libertad:** Otuzco, 29 June 1914, *Weberbauer 6998* (B).

10. Ocotea infrafoveolata van der Werff, Ann. Missouri Bot. Gard. 78: 417. 1991. TYPE: Ecuador. Zamora Chinchipe: Loja–Zamora rd. at the pass, 2900 m, 12 Feb. 1985, *G. Harling & L. Andersson 21968* (holotype, GB; isotype, MO-3785002).

Shrub or tree to 20 m; twigs angular, 5–7 mm diam., solid, dark brown tomentellous when young, becoming glabrous with age; terminal buds densely rusty brown tomentose. Leaves 6–15 × 2.5–6 cm, alternate, elliptic to elliptic-oblong, rarely narrowly elliptic, coriaceous, base gradually narrowed, inrolled and decurrent on the petiole, margin plane to revolute, apex acute; upper surface tomentose, indument soon disappearing and upper surface glabrous and shiny, lower surface appearing pitted, tomentose with a dense ferruginous indument, this wearing off with age; domatia absent; midvein and secondary veins immersed on the upper surface, but, together with the tertiary venation, prominently raised on the lower surface, tertiary venation reticulate, secondary veins 10 to 15 pairs; petioles to 1 cm × 5 mm, flat, but poorly defined because of the decurrent leaf bases. Inflorescences 10–16 cm, axillary, paniculate, ferruginous tomentose. Flowers perfect or pistillate, yellowish green, sessile or nearly so, covered with a ferruginous indument. Hermaphrodite flowers 7–10 mm diam.; pedicels ca. 0.2 mm, densely pubescent tepals six, 3.5 × 2.5 mm, spreading at anthesis, densely pubescent on the inner surface; stamens 9, all 4-locular, outer 6 stamens 2 mm, glabrous or with a few hairs, filament as long as the anther, locelli introrse, inner 3 stamens with the same dimensions; glands present at the base of the inner stamens; staminodia not seen; receptacle cup-shaped, pubescent inside; pistil ca. 3 mm, glabrous, style twice as long as the ovary, stigma platelike, at the same level as the stamens. Pistillate flowers 6 mm diam.; pedicels ca. 0.2 mm, densely pubescent, tepals six, 0.3 mm, densely pubescent, erect; outer 6 stamens 1.3 mm, remnants of the locelli visible, but flaps not opened, inner 3 stamens 1.4 mm, locelli not opened, but visible; glands present at the base of the inner stamens; pistil 3.5 mm, stigma conspicuous, 1 mm diam., above the level of the staminodia; receptacle deep, glabrous inside, densely pubescent outside. Fruits to 3 × 2.5 cm; cupule shallowly bowl-shaped to platelike, to 1.8 cm diam.; pedicel swollen, tepals deciduous in the fruiting stage.

Discussion. *Ocotea infrafoveolata* is easily recognized by the combination of the reticulate tertiary venation, giving the lower leaf surface a pitted appearance; the inrolled, decurrent leaf bases; and the large flowers. It is known from northern Peru and southern Ecuador to southern Colombia, but is most frequent in southern Ecuador and northern Ecuador through southern Colombia; it is rarely collected in central Ecuador. The altitudinal distribution is from 2600 to 3400 m. Its closest relative is probably *O. loxensis*, a shrub from southern Ecuador, which differs in having smaller leaves and flowers, but shares with *O. infrafoveolata* a pitted lower leaf surface and seemingly hermaphroditic and pistillate flowers.

In 1991, I described *Ocotea infrafoveolata* as having hermaphroditic flowers, although I noted two flower sizes. With more specimens at hand, I now consider this species to have perfect and pistillate flowers, a condition known in a few other *Ocotea* species (*O. minarum* group sensu Rohwer, 1986). The reasons for this change are the glabrous receptacle, staminodia that are clearly shorter and narrower than the stamens, and the stigma raised above the staminodia in the pistillate flowers, while in the perfect flowers the receptacle is pubescent, stamens are larger and have opened locelli, and stamens and stigma are at the same level. None of the specimens seen for *O. infrafoveolata* had young fruits with stamens attached, and it is not known if fruits develop from the smaller flowers or from the larger ones.

Three collections from northern Peru (department of Cajamarca, San Ignacio) differ in having narrower, longer leaves (to 19 × 4 cm) and smaller fruits (to 1.7 × 1 cm). Flowering specimens are not yet known from Peru.

IUCN Red List category. *Ocotea infrafoveolata* has been assessed as Near Threatened (NT), based on IUCN (2001) criteria.

Selected specimens seen. COLOMBIA. **Cauca:** Vía Cali-Silvia, Páramo de Moras, Jan. 1978, *Cuadros 359* (MO). **Quindío:** Salento, Reserva del Alto Quindío Acaime, 11 Jan. 1990, *Renjifo 86* (MO). **Valle del Cauca:** Mun. El Cerrito, Highway Tenerife-Páramo de Pan de Azúcar, 2 Apr. 1993, *Silverstone-Sopkin et al. 6539* (MO). ECUADOR. **Azuay:** Cantón Nabón, carretera Nabón–Cuenca, 28 Dec. 1991, *Rubio et al. 2296* (MO). **Carchi:** Cantón Montúfar, loma El Corazón, 18 June 1989, *Tipaz 87* (MO). **Loja:** rd. Loja–Zamora, close to pass "El Tiro," 21 Oct. 2004, *Homeier et al. 1422* (MO). **Morona Santiago:** rd. Gualaceo–El Limon, 7 Feb. 1989, *van der Werff & Palacios 10468* (MO). **Napo:** Cantón Sucumbios, El Playón de San Francisco, 23 May 1985, *Jaramillo 7686* (MO). **Zamora Chinchipe:** Parque Nac. Podocarpus, just E of the pass on rd. Loja–Zamora, 1 Mar. 1985, *Øllgaard et al. 58476* (MO). PERU. **Cajamarca:** San Ignacio, San José de Lourdes, 19 Aug. 1998, *Campos et al. 5607* (MO).

11. Ocotea jelskii Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 261 (1889). TYPE: Peru. Tambillo: 21 July 1878, *C. de Jelski 205* (lectotype, designated here, B; isotypes, K not seen, MO, P not seen).

Small trees to 12 m; twigs terete, 3 mm diam., solid, brown-tomentose or tomentellous; terminal buds densely tomentose. Leaves 5–12 × 2–4 cm, alternate, narrowly elliptic to lanceolate, firmly chartaceous, base obtuse to acute, margin plane, apex acute to acuminate, upper leaf surface sparsely appressed pubescent, becoming glabrous with age, lower surface ferruginous tomentellous; domatia absent; venation immersed on both surfaces and difficult to discern, secondary veins ca. 7 on each side; petioles 7–10 mm, canaliculate, pubescent. Flowers 3.5 mm diam., green; pedicels to 1.5 mm, densely pubescent; tepals six, 1.7 × 1 mm, densely pubescent outside, sparsely pubescent on the inner surface, half erect at anthesis; stamens 9, all 4-locular, outer 6 stamens 1.3 mm, filament short, with a few hairs, anther glabrous, inner 3 stamens 1.5 mm, filament 0.6 mm, pubescent; glands present at the base of the inner stamens; staminodia rather large, 1.5 mm, pubescent; pistil 2 mm, glabrous, style 0.5 mm; receptacle deep, pubescent inside, densely pubescent outside. Fruits ellipsoid, 1.7 × 1.2 cm; cupule cup-shaped, 7 mm high, 1 cm wide, tepals deciduous in the fruiting stage.

Discussion. *Ocotea jelskii* is best recognized by its narrowly elliptic to lanceolate leaves with inconspicuous venation. The relatively large staminodia are also worth noting. The upper surface of the young leaves is more pubescent than usual in this group of species. The name has been applied to specimens belonging to several different species, but I have seen only one recent collection of *O. jelskii*. Mez cited four collections in his description, and I have seen three of those (see syntypes cited below).

Flowering specimens were collected in July and December, fruiting in July and September to April. The altitudinal range is known only for the recent collection; it was found at 2300 m. The common name listed on the lectotype is Ishpingo griseo; *C. de Jelski 167* and *C. de Jelski 190* have the common name Ishpingo Oberillo.

IUCN Red List category. *Ocotea jelskii* has been assessed as Data Deficient (DD), based on IUCN (2001) criteria.

Additional specimens seen. PERU. **Amazonas:** Chachapoyas Province, Molinopampa, 26 Dec. 2000, *Vasquez & Rojas 26761* (F, HBG, MO). **Tambillo:** *C. de Jelski 167* (B, MO syntypes), *C. de Jelski 190* (B syntype); "Sandillani," *Pearce s.n.* (K syntype, not seen).

12. Ocotea loxensis van der Werff, sp. nov. TYPE: Ecuador. Loja: El Tiro, shrubby paramo along rd. Loja–Zamora, at highest point, ca. 10 km from Loja, 3000 m, 03°59′S, 79°10′W, 23 Nov. 2004, *H. van der Werff, B. Gray, J. Ronquillo & W. Quizhpe 19600* (holotype, MO-6351394; isotypes, B, F, HBG, K, LOJA, MO-6351395, NY, P, QCNE, US). Figure 6.

Ocoteae infrafoveolatae van der Werff affinis, sed ab ea foliis minoribus basi vix revoluta recedit; *Perseae ferrugineae* Kunth similis, sed ab ea tepalis aequalibus et fructibus cupulis insidentibus differt.

Shrubs to 2 m; twigs terete or angular, 2–4 mm diam., solid, dark brown puberulous, the surface only partially covered at the level of inflorescences, becoming glabrous with age; terminal buds ferruginous tomentellous. Leaves 3–6 × 1.5–2.8 cm, alternate, elliptic, coriaceous, base acute or obtuse, plane or slightly revolute, margin plane, apex bluntly acute; domatia absent; midrib immersed, secondary veins inconspicuous, slightly raised, the higher order venation forming finely reticulate and slightly raised on the upper surface, venation raised and reticulate on the lower surface, upper surface glabrous, lower surface ferruginous tomentellous, surface completely covered, but the indument on the venation wearing off and the venation glabrous on older leaves, secondary veins inconspicuous, 7 to 10 on each side; petioles 5–8 mm, flat or slightly canaliculate above, with a similar indument as the twigs. Inflorescences 4–9 cm, paniculate-cymose, in the axils of leaves, minutely puberulous, but the surface not completely covered. Flowers 6–7 mm diam., yellow-green; pedicels ca. 2 mm, dark brown puberulous; tepals six, 2.5 mm, elliptic, spreading at maturity, dark brown puberulous on the outer surface, lighter brown pubescent on the inner surface; stamens 9, all 4-locular, outer 6 stamens 1.8 mm, filaments 0.7 mm, dorsally pubescent and anthers glabrous, inner 3 stamens about the same size, but with glabrous filaments; glands present at the base of the inner stamens; staminodia lacking; pistil 2.3 mm, glabrous, style about as long as the slender ovary, stigma flat, receptacle deep, glabrous inside, pubescent outside. Fruits rounded, 7 × 6 mm; cupule bowl-shaped, 7–8 mm diam., margin simple, tepals deciduous in the fruiting stage.

Discussion. *Ocotea loxensis* is closely related to *O. infrafoveolata*, having similar finely reticulated leaves and gynodioecious flowers. The new species differs in having smaller leaves (3–6 cm vs. 6–15

Figure 6. Holotype of *Ocotea loxensis* van der Werff (*H. van der Werff et al. 19600*, MO).

cm), flowers (6–7 mm vs. 7–10 mm diam.), tepals (2.5 mm vs. 3.5 mm), fruits (0.7 cm vs. 3 cm), and cupules (7–8 mm vs. 18 mm diam.). It lacks the decurrent, revolute base of the leaves that characterizes *O. infrafoveolata*. The fruits, known from one collection of *O. loxensis*, were described as green, turning black, and were probably approaching maturity. The two flowering collections both had well-developed stamens with some pollen grains still attached to the flaps, whereas the fruiting collection had staminodia

(1 mm, the locelli visible, but not opened), suggesting that *O. loxensis* is also gynodioecious. The pistil in the hermaphrodite flowers is rather slender. Vegetatively, this species resembles *Persea ferruginea* Kunth; however, that species has unequal tepals and staminodia.

One collection of *Ocotea loxensis* (*Lægaard et al. 58015*, MO) had been previously identified as *O. infrafoveolata*. *Ocotea loxensis* is known from three collections in Ecuador, all made in the vicinity of Loja, at altitudes between 3000 and 3300 m. Flowers have been collected in November and February.

IUCN Red List category. *Ocotea loxensis* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Paratypes. ECUADOR. **Loja:** Parque Nac. Podocarpus, mtn. crest with low scrub above "Centro de Información," 79°10′W, 04°05′S, 3050–3300 m, 23 Feb. 1985, *S. Lægaard, K. Thomsen, J. Korning & T. Illum 58015* (MO); Parque Nac. Podocarpus, trail to "El Mirador," 04°07′14″S, 79°10′37″W, 3020–3160 m, 2 Nov. 2000, *P. Jørgensen, C. Ulloa & J. Caranqui 2164* (F, HBG, MO).

13. Ocotea micrantha van der Werff, sp. nov. TYPE: Bolivia. La Paz: Nor Yungas Prov., 9 km de Huancane en carr. a San Isidro, 2540 m, 67°31′W, 16°31′S, 12 Dec. 1989, *D. Smith & V. García 13896* (holotype, MO-6351397; isotypes, B, F, G, HBG, K, LPB, MO-6351396, NY, P, US). Figure 7.

Ocoteae arnottianae (Nees) van der Werff similis, sed ab ea floribus minoribus et foliis obovatis vel obovato-ellipticis recedit.

Trees 20 m; twigs terete, 3–5 mm diam., densely ferruginous tomentellous or tomentose, the surface completely covered; terminal buds ferruginous pubescent. Leaves 4–7.5 × 2–4 cm, alternate, obovate or obovate-elliptic, firmly chartaceous, becoming coriaceous with age, upper surface puberulous when young, soon becoming glabrous, lower surface ferruginous tomentose-tomentellous, surface completely covered, base acute to obtuse, margin plane, apex obtuse or bluntly acute; domatia absent; midrib and secondary veins immersed when young, slightly impressed when older, tertiary venation immersed on the upper surface, venation raised on the lower surface; secondary veins 6 to 8 on each side; petioles 4–7 mm, flat above, with a similar indument as the twigs. Inflorescences 2–7 cm, paniculate-cymose, the flowers in the distal half of the inflorescence, densely ferruginous tomentellous. Flowers 3.5–4 mm diam., cream-colored, subsessile, gradually narrowed into a very short (ca. 0.2 mm), pubescent pedicel; tepals six, 1.2–1.5 mm, spreading, pubescent on both surfaces; stamens 9, all 4-locular, glabrous, outer 6 stamens bent inward, ca. 1.2 mm, inner 3 stamens erect, straight, ca. 1.7 mm; glands present at the base of the inner stamens; staminodia present, 0.7 mm, stipitiform, glabrous; pistil 1.5 mm, glabrous, style a little shorter than the ovary, stigma flat; receptacle fairly shallow, glabrous inside or with some hairs near the top, pubescent outside. Fruits and cupule unknown.

Discussion. *Ocotea micrantha* resembles *O. arnottiana* vegetatively, but differs from that species in its smaller flowers (4 mm vs. 6.5–9 mm diam.), smaller tepals (1.2–1.5 mm vs. 2.7–3.2 mm), and the obovate-elliptic to obovate leaves. There is also a difference in habit: *O. micrantha* is a 20 m tree, whereas *O. arnottiana* is a shrubby species, rarely reaching 5 m in size. *Ocotea micrantha* is only known from the type collection from Province Nor Yungas, La Paz, Bolivia.

IUCN Red List category. *Ocotea micrantha* has been assessed as Data Deficient (DD), based on IUCN (2001) criteria.

14. Ocotea pajonalis van der Werff, sp. nov. TYPE: Peru. Pasco: Distr. Oxapampa, Parque Nac. Yanachaga-Chemillén, sector Chacos-Antena, 2750 m, 10°37′S, 75°17′W, *R. Vasquez, J. Perea, A. Peña, R. Francis & L. Mateo 28546* (holotype, MO-6351392; isotypes, B, F, G, HOXA, USM). Figure 8.

Ocoteae arnottianae (Nees) van der Werff similis, sed ab ea receptaculo intus pubescenti, fructibus majoribus et tepalis post anthesin deciduis recedit.

Shrub or rarely a small tree to 5 m; twigs terete or slightly angular, to 4 mm in diam., solid, densely brown tomentellous-tomentose, surface completely covered, indument paler and ultimately wearing off with age; terminal buds densely tomentose. Leaves 3.5–9 × 1.8–4 cm, alternate, elliptic, coriaceous, base obtuse to cuneate, margin plane, apex acute to obtuse, lower surface rusty brown tomentose, color fading with age to pale brown, upper surface glabrous; domatia absent; venation immersed or slightly impressed on the upper surface, raised on the lower surface, tertiary venation reticulate, indument on the veins of the lower leaf surface paler than on the surrounding laminar tissue and the venation readily visible, secondary veins 5 to 9 on each side; petioles 2–5 mm, shallowly canaliculate. Inflorescences 4–11 cm, in the axils of leaves, densely rusty tomentose, paniculate, flowers crowded near the tips of the first-order branches. Flowers 5 mm diam., rusty tomentose, green or yellow, sessile or nearly so, half erect; tepals 6, equal, 2 × 1 mm, tomentose, but

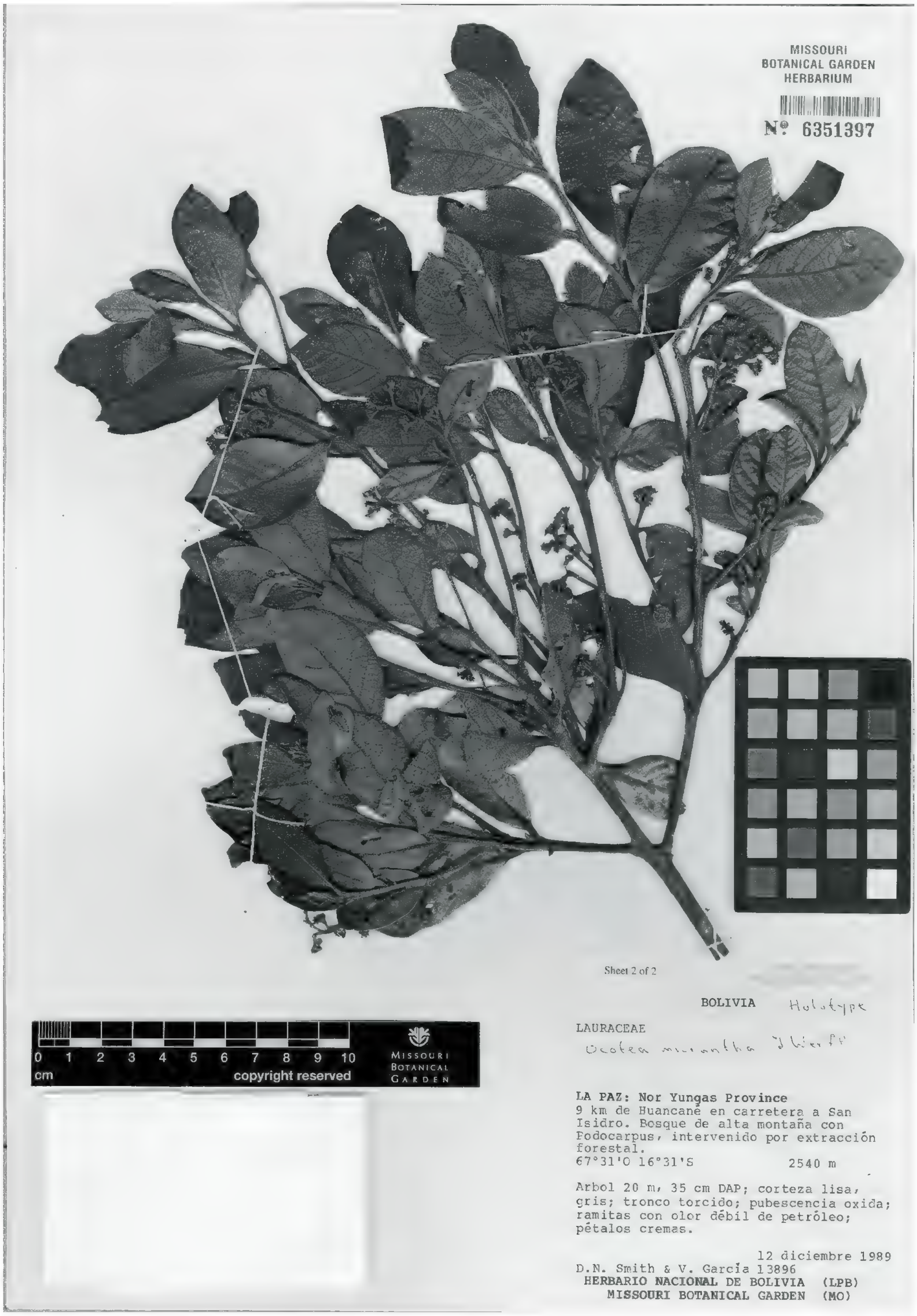

Figure 7. Holotype of *Ocotea micrantha* van der Werff (*D. Smith & V. García 13896*, MO).

slightly less densely pubescent than the receptacle; stamens 9, all 4-locular, outer 6 stamens 1.5 mm, filament 0.5 mm, pubescent, anther 1 mm, glabrous, inner 3 stamens 1.2 mm, pubescent filament half as long as the glabrous anther; gland present at the base of the inner stamens; staminodia not seen; receptacle deep, pubescent inside and outside. Fruits large, to 2.8 × 2.4 cm, cotyledons purple; cupule bowl- to cup-shaped, to 2.7 cm wide, 2 cm high, with a single margin, tepals deciduous in the fruiting stage.

Figure 8. Holotype of *Ocotea pajonalis* van der Werff (*R. Vasquez et al. 28546*, MO).

Discussion. *Ocotea pajonalis* is known only from the Cordillera de Yanachaga, where it is locally common in shrubby vegetation on poor, sandstone-derived soils called pajonal. It is easily recognized by its shrubby habit, the rusty brown pubescent leaves, the reticulate tertiary venation and the relatively large fruits. It has been confused with *O. arnottiana*, a shrubby species on similar sandstone-derived soils from Amazonas, Cajamarca, and Pasco, Peru. The latter differs in its flowers with a glabrous receptacle,

the smaller fruits and cupules, and its tepals are persistent on the cupules. Several collections of *O. pajonalis* have previously been distributed as *O. arnottiana*.

On cutting a fruit of *Ocotea pajonalis*, the inside of the cotyledons was found to be purple. In most Lauraceae, cut fruits are whitish; it is not known if the purple color is characteristic for this species or whether the color is associated with the maturity of the fruits. Flowers have been collected from October to February; fruiting collections have been made from March to November. It has been recorded at altitudes from 2500 to 2900 m.

IUCN Red List category. *Ocotea pajonalis* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Paratypes. PERU. **Pasco:** Distr. Oxapampa, Parque Nac. Yanachaga-Chemillén, sector Chacos-Antena, 10°37′S, 75°17′W, *C. Arias, R. Francis & C. Rojas 225* (MO), *R. Foster 9009* (MO), *A. Monteagudo, A. Peña, R. Francis, C. Arias & C. Rojas 7504* (F, G, K, MO), *R. Rojas, J. Lingan, K. Meza & C. Rojas 1532* (B, MO, US), *R. Rojas, J. Lingan, K. Meza & J. Macedo 2128* (F, HBG, MO, UC), *R. Rojas, M. Huaman, A. Peña, J. Mateo & C. Rojas 2586* (G, K, MO, NY), *H. van der Werff, R. Vasquez, B. Gray, R. Ortiz & N. Davila 18666* (B, G, K, MO, NY), *18670* (B, F, HBG, K, MO, NY, P, US), *18706* (B, K, MO, US), *H. van der Werff, A. Monteagudo, A. Peña, R. Francis & C. Rojas 19704* (F, G, HBG, MO, NY), *H. van der Werff, A. Peña & C. Rojas 23202* (MO), *R. Vasquez, J. Perea, A. Peña, R. Francis & L. Mateo 28550* (F, HBG, MO, US), *R. Vasquez, A. Monteagudo, A. Peña & R. Francis 28915* (MO), *R. Vasquez, A. Monteagudo & L. Mateo 30753* (F, HBG, MO, P), *R. Vasquez, G. Castillo, V. Flores, L. Hernani & D. Vasquez 32728* (B, F, MO, US), *R. Vasquez, A. Monteagudo, A. Peña & J. Mateo 34518* (B, MO, NY); Distr. Oxapampa, Milpo, 10°23′01″S, 75°37′46″W, *H. van der Werff, R. Vasquez, A. Peña, L. Mateo & R. Rivera 23077* (B, MO, NY, US), *23081* (F, HBG, MO); Distr. Oxapampa, La Suiza Vieja, 10°40′17″S, 75°30′45″W, *H. van der Werff, R. Vaquez & C. Arias 22885* (HBG, MO); Distr. Oxapampa, Parque Nac. Yanachaga-Chemillén, Refugio Abra Esperanza, 10°31′5″S, 75°20′59″W, *Cueva 585* (MO); Distr. Chontabamba, sector La Suiza, 10°38′44″S, 75°27′22″W, *A. Monteagudo, A. Peña, R. Francis, C. Arias & C. Rojas 7889* (MO), *7913* (B, F, MO, US); Distr. Chontabamba, La Suiza Nueva, 10°38′00″S, 75°27′00″W, *R. Vasquez, A. Monteagudo, L. Valenzuela, J. Perea & L. Mateo 30388* (MO, US); Distr. Huancabamba, Zona de amortiguamiento, 10°19′18″S, 75°36′00″W, *A. Monteagudo, L. Cardenas, A. Peña, J. Mateo & R. Francis 12169* (MO, NY); Oxapampa–Cerro de Pasco rd., San Gutardo, 10°40′S, 76°0′W, *A. Gentry, D. Smith, R. Vasquez & B. Leon 39980* (MO), *40016* (MO).

15. Ocotea palaciosii van der Werff, sp. nov. TYPE: Ecuador. Carchi: Montúfar, al E de Mariscal Sucre, 3200 m, 0°36′N, 77°42′W, 3 Jan. 1994, *W. Palacios 11976* (holotype, MO-6351386; isotypes, B, NY, P, QCNE not seen, US). Figure 9.

Ocoteae benthamianae Mez affinis, sed ab ea foliis minoribus, costa sicut nervis secundariis impressis et tepalis extus pubescentibus recedit.

Trees 6 m or more; twigs terete or slightly angular, 3–4 mm diam., solid, densely pubescent, hairs short, mostly appressed, becoming sparser on older twigs; terminal buds densely appressed pubescent. Leaves 6–13 × 3–6.5 cm, alternate, elliptic, coriaceous, base acute or obtuse, margin plane or a little revolute at the base, apex acute; lower leaf surface ferruginous pubescent, hairs short, erect, curly, covering the surface completely, upper surface glabrous; domatia absent; upper surface with impressed midrib and secondary veins, tertiary venation immersed or slightly impressed, lower surface with midrib and secondary veins raised, tertiary venation slightly raised, secondary veins 5 to 6 on each side; petioles 12–18 mm, deeply canaliculate, densely appressed pubescent when young, becoming glabrous with age. Inflorescences 5–7 cm, paniculate cymose, in the axils of leaves, densely appressed pubescent. Flowers 4–5.5 mm diam., yellow; pedicels 3 mm, pubescent; tepals six, 2–2.5 × 1–1.5 mm, half erect to spreading, pubescent to sparsely pubescent outside, inner surface pubescent, united at the base and falling as a unit in old flowers; stamens 9, all 4-locular, outer 6 stamens 1.25 mm, the filament pubescent, one third as long as the anther, inner 3 stamens 1.7 mm, filament pubescent; glands present at the base of the inner stamens; staminodia present, 0.7 mm, stipitiform, filament pubescent, apex thickened, glabrous; pistil 2.5 mm, ovary 1.5 mm, stigma platelike, receptacle deep, pubescent inside, outside appressed pubescent. Fruits and cupule not known.

Discussion. *Ocotea palaciosii* shares with *O. benthamiana* the dense, ferruginous indument on the lower leaf surface and the densely pubescent interior of the receptacle. It differs from that species in its smaller leaves (6–13 × 3–6.5 cm vs. 12–27 × 6.5–10 cm) and the impressed midrib and secondary veins (vs. immersed in *O. benthamiana*). The tepals of *O. palaciosii* are pubescent to sparsely pubescent but are not glabrous and do not contrast clearly with the pubescent hypanthium of the flowers.

This new species is dedicated to the Ecuadorian botanist Walter A. Palacios, the collector of the type of this species. Flowering was observed in November, December, and January. The altitudinal distribution of *Ocotea palaciosii* extends from 1400 to 3200 m.

Figure 9. Holotype of *Ocotea palaciosii* van der Werff (*W. Palacios 11976*, MO).

One collection (*Luteyn & Cotton 11018*, MO) was taken from a forest tree of 50 cm at dbh but without indication of its size; the other collections were small trees to 8 m tall or shrubs.

Collections of *Ocotea palaciosii* from southern Ecuador (provinces Zamora Chinchipe, Morona Santiago, and northern Peru) differ somewhat from the specimens from northern Ecuador (provinces

Carchi and Napo). In the southern material, the venation is less prominently impressed, the leaf shape is slightly more oblong, and the flowers appear somewhat smaller (Table 1). There are also small differences in the length of the stamens and staminodia. These differences appear significant, but do not warrant recognition of the southern collections as a distinct taxon, at least not now. More and especially better specimens are needed from the southern range; most of the existing collections are in bud or have young flowers. Some paratypes were previously identified as *Ocotea* aff. *benthamiana*, *O. benthamiana*, or *O. heterochroma*, and duplicates may have been distributed under those names.

IUCN Red List category. *Ocotea palaciosii* has been assessed as Near Threatened (NT), based on IUCN (2001) criteria.

Paratypes. ECUADOR. **Carchi:** Montúfar Canton, Loma el Corazon al SE de Mariscal Sucre, 00°35′N, 77°42′W, 3150 m, 22–23 Dec. 1992, *W. Palacios & G. Tipaz 10575* (MO). **Morona Santiago:** E of Río Quimi, 03°30′45″S, 78°24′33″W, 2000 m, 11 Dec. 2000, *D. Neill, R. Tsakimp & QCNE botany interns 12966* (MO). **Napo:** 8–12 km ESE of Santa Barbara, 0°40′N, 77°30′W, 2780–2880 m, 11 Jan. 1985, *J. Luteyn & E. Cotton 11018* (MO). **Zamora Chinchipe:** Nangaritza Canton, Cima del Cordillera del Condor, arriba de Pachicutza, 78°34′W, 04°07′S, 1850 m, 5 Dec. 1990, *W. Palacios & D. Neill 6509, 6512* (MO); Nangaritza, "Nangaritza Upper Sandstone Plateau Plot," 04°15′32″S, 78°41′04″W, 1620 m, 6 Nov. 2006, *D. Neill & NSF Dendrology Course 15426* (MO); vic. mining camp at Rio Tundaime, along trail to drilling sites, 03°34′44″S, 78°24′11″W, 1400 m, 10 Nov. 2004, *H. van der Werff, B. Gray, J. Ronquillo & W. Quizhpe 19474* (MO); El Pangui, Cresta de la Cordillera en la frontera Ecuador-Peru, 03°38′32″S, 78°23′36″W, 2000 m, 15 Dec. 2000, *M. Cerna, D. Neill & Grupo de Post-Grado MO-QCNE 427* (MO). PERU. **Cajamarca:** San Ignacio, Buenos Aires del Parco Cerro, 05°04′38″S, 78°53′30″W, 2190 m, 9 Nov. 2000, *M. Huamán, R. Vasquez, J. Campos, G. Calatayud & B. Córdova 36* (MO).

16. Ocotea pautensis van der Werff, sp. nov. TYPE: Ecuador. Azuay: Paute Canton, carr. Paute–Sevilla de Oro, 1–2 km al N de Sevilla de Oro, 02°40′S, 78°40′W, 2500 m, 29 Dec. 1991, *D. Rubio, C. Aulestia & K. Edwards 2302* (holotype, MO-6351393; isotypes, B, G, QCNE not seen, US). Figure 10.

Ocoteae umbrinae van der Werff similis, sed ab ea basi foliorum breve angustata (nec rotundata) et inflorescentiis longioribus recedit.

Trees to 15 m; twigs angular, 5 mm diam., solid, velvety pubescent, indument covering the twigs completely; terminal buds densely pubescent. Leaves 9–13 × 6–8 cm, alternate, broadly elliptic, coriaceous,

Table 1. Morphological comparison of *Ocotea palaciosii* collections from southern Ecuador, provinces Zamora Chinchipe and Morona Santiago, northern Peru from Cajamarca (South populations), and northern Ecuador provinces Carchi and Napo (North populations). Sample size refers to the number of flowers.

O. palaciosii	Average	Range	Sample size
North			
Floral diameter (mm)	4.5	4.1–5	8
Pedicel length (mm)	3	2.5–4	6
Tepal length (mm)	2	1.6–2.1	8
Pistil length (mm)	2.5	2.4–2.8	8
South			
Floral diameter (mm)	3	2.2–3.5	6
Pedicel length (mm)	0.6	0.5–1	5
Tepal length (mm)	1.4	1.2–1.5	4
Pistil length (mm)	1.8	1.6–2	5

base shortly attenuate, often slightly reflexed, margin plane, apex obtuse or shortly acute, lower surface densely rusty brown pubescent, the hairs erect, curly, upper surface sparsely tomentellous when young, especially near the base and on the midrib, becoming glabrous and lustrous with age; domatia absent; midrib and secondary veins impressed and tertiary venation immersed on the upper surface, midrib and secondary veins prominently raised, tertiary venation slightly raised and scalariform on the lower surface, secondary veins 8 to 11 on each side; petioles 8–12 mm, flat above, tomentellous. Inflorescences in the axils of leaves, 15–20 cm, paniculate-cymose, brown, velvety. Flowers 4.5–5.5 mm diam., greenish yellow, pedicels ca. 3 mm, densely pubescent; tepals six, 2 × 2 mm, broadly elliptic, spreading at anthesis, pubescent on both surfaces; stamens 9, all 4-locular, outer 6 stamens ca. 1.2 mm, filament 0.5 mm, glabrous or with a few hairs, anther 0.7 mm, glabrous, anther curved inward under a 90° angle with the filament, inner 3 stamens 1.2 mm, erect; glands present at the base of the inner stamens; staminodia not seen; pistil glabrous, 2 mm, style as long as the ovary; receptacle shallow, pubescent inside, densely pubescent outside. Fruits and cupule not known.

Discussion. *Ocotea pautensis* is best recognized by its broadly elliptic leaves with impressed major veins, the densely velutinous indument on the lower leaf surface and inflorescences, the short petioles that are flat (not canaliculate) above, and the broad tepals with a rounded tip.

Ocotea pautensis is closely related to *O. umbrina*; the two species share the flat petioles, broad and rounded tepals, and impressed major veins, but differ in the shape of their leaf base (shortly attenuate in *O. pautensis*, rounded in *O. umbrina*), the length of the

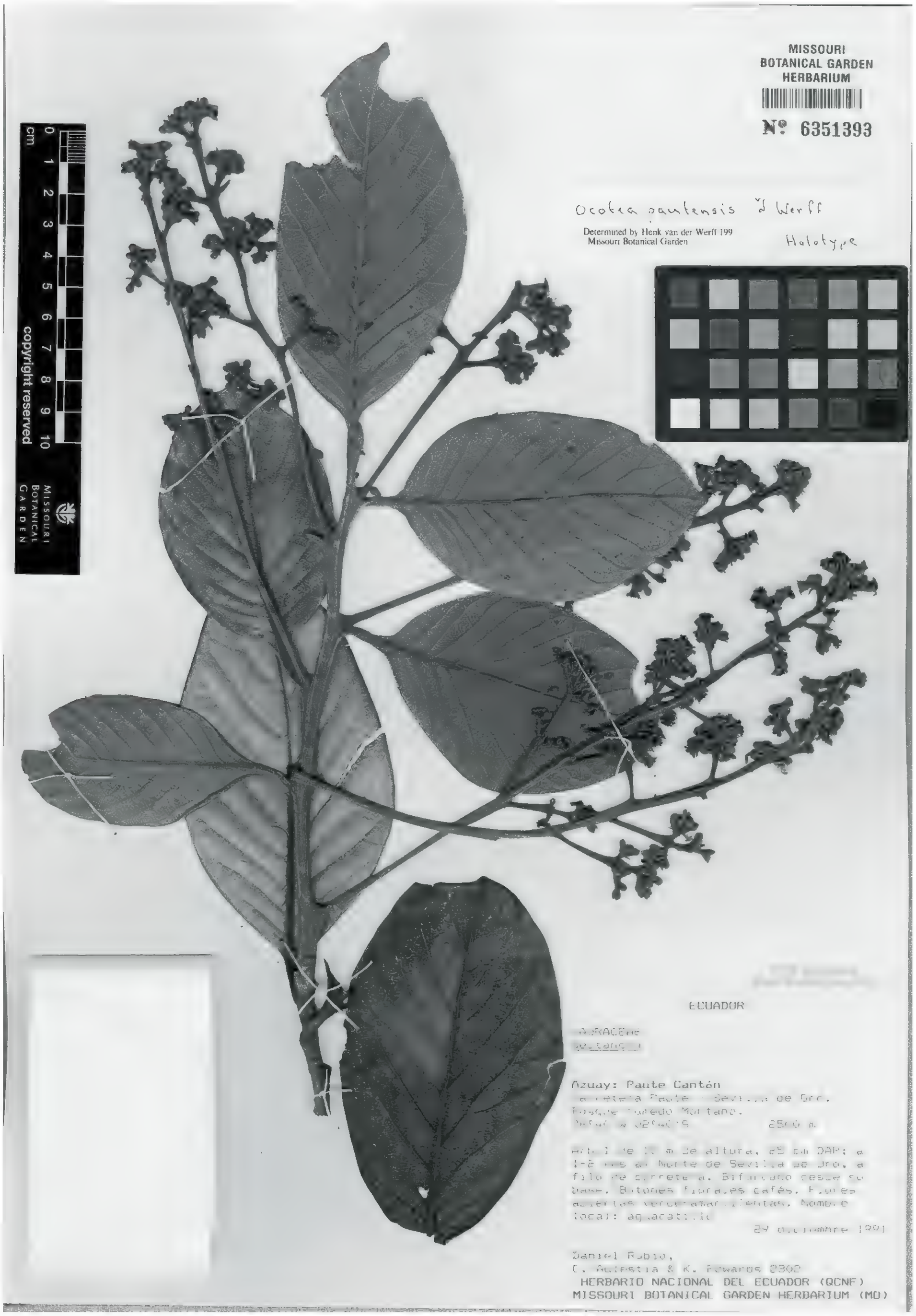

Figure 10. Holotype of *Ocotea pautensis* van der Werff (*D. Rubio et al. 2302*, MO).

inflorescences (15–20 cm in *O. pautensis* vs. to 10 cm in *O. umbrina*), and the color of the indument (rusty brown in *O. pautensis*, raw umber in *O. umbrina*). *Ocotea cuatrecasasii* van der Werff from Colombia is also related, but differs in its fistulose twigs and short, tomentellous indument on twigs and leaves. The flat petiole, rounded tepals, and lack of staminodia suggest that these species are not part of

the *O. aciphylla* (Nees) Mez group sensu Rohwer (1986). *Ocotea pautensis* is known only from two collections, made on the same day by the same collectors at slightly different locations at 2500 m altitude.

IUCN Red List category. *Ocotea pautensis* has been assessed as Data Deficient (DD), based on IUCN (2001) criteria.

Paratype. ECUADOR. **Azuay:** E of Paute, betw. El Pan & Las Palmas, 02°42′S, 78°38′W, 2500 m, 29 Dec. 1991, *K. Edwards, D. Rubio, C. Aulestia & S. Espinoza 561* (MO).

17. Ocotea pedicellata van der Werff, sp. nov. TYPE. Colombia. Quindío: Salento, Reserva del Alto Quindío Acaime, 04°37′N, 75°32′W, 2850 m, 15 Sep. 1989, *L. M. Renjifo 67* (holotype, MO-3913467). Figure 11.

Ocoteae heterochromae Mez & Sodiro similis, sed ab ea pubescentia foliorum tomentella (nec appressa) et cupula minore simplicimarginata recedit.

Trees to 16 m; twigs slightly angular to terete, 5 mm diam., solid, densely brown tomentellous, becoming glabrous with age; terminal buds densely brown tomentellous. Leaves 8–13 × 4–8 cm, alternate, elliptic to broadly elliptic, stiffly chartaceous to coriaceous, base acute to obtuse, margin flat, apex acute or shortly acuminate, lower surface densely brown to yellow-brown tomentellous, upper surface glabrous, often shiny; domatia absent; midrib and secondary veins impressed, tertiary venation slightly impressed on the upper surface, midrib, secondary veins, and tertiary venation raised on the lower surface, secondary veins 4 to 7 on each side; petioles 7–12 mm, shallowly canaliculate, the pubescence similar as on the twigs. Inflorescences to 10 cm, paniculate-cymose, densely tomentellous, in the axils of leaves. Flowers 5 mm diam., yellow; pedicels distinct, 4–5 mm, as long as or longer than the flowers, pubescent; tepals six, 2 mm, elliptic, half erect, ultimately spreading before breaking off, sparsely to moderately pubescent on the outer surface, less densely pubescent than the receptacle, inner surface sparsely pubescent; stamens 9, all 4-locular, outer 6 stamens 1.7 mm, filament pubescent, anther curved toward the center of the flower, inner 3 stamens erect, ca. 1.5 mm, filament pubescent and a little shorter than the anther; glands present at the base of the inner stamens; staminodia present, ca. 0.5 mm, stipitiform, with a few hairs, tip somewhat swollen; pistil 2 mm, glabrous, ovary gradually narrowed in the style; receptacle deep, glabrous or with a few hairs appressed inside, pubescent outside. Fruits broadly ellipsoid, 2 × 1.8 cm; cupule shallow, 8 mm high, 1–1.4 cm diam., tepals deciduous in the fruiting stage.

Discussion. *Ocotea pedicellata* is best distinguished from the other species by its dense tomentellous indument, the (nearly) glabrous interior of the receptacle, and relatively small leaves by its pedicellate flowers, with the pedicels as long as the flowers, the basal secondary veins close together, and the prominently raised venation on the lower leaf surface. The outer surface of the tepals is less pubescent than the outside of the receptacle, but this difference is not as pronounced as in *O. gentryi*, also known from Colombia. The new species is known only from the departments of Quindío, Tolima, and Cundinamarca in Colombia, at altitudes of 1980–2900 m. The two cited collections from Cundinamarca have fewer coriaceous leaves and the major veins are not as prominently raised as in the other collections from Quindío and Tolima in Colombia. Three collections had been previously identified as *O. heterochroma* (*Madriñan et al. 726*, *744*, *Renjifo 67*) and two as *O. discolor* Kunth (*Madriñan et al. 741*, *Vargas 527*), and duplicates may have been distributed under those names.

IUCN Red List category. *Ocotea pedicellata* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Paratypes. COLOMBIA. **Cundinamarca:** Cordillera Oriental, entre San Miguel y Aguadita, 2360 a 1980 m, 21 Apr. 1946, *H. Garcia-Barriga 12063* (US); Boca de Monte, W margin of Sabana de Bogotá, 2800 m, 9 Sep. 1961, *J. Cuatrecasas, R. Jaramillo & G. Huertas 25824* (F, US). **Quindío:** Mpio. Salento, Vereda Cocora, 2800 m, Oct. 1992, *W. Vargas 704* (MO); Mpio. Salento, La Marina, 2800 m, July 1992, *W. Vargas 527* (MO); Mpio. Salento, Reserva Nac. Acaime, Sendera al Mirador, 75°30′W, 04°40′N, 2900 m, 14 Mar. 1993, *S. Madriñan, S. Arango & M. Salazar 726* (MO). **Tolima:** La Carbonera, 04°40′N, 75°20′W, 2750 m, 16 Mar. 1993, *S. Madriñan, S. Arango & M. Salazar 741* (MO), *744* (MO).

18. Ocotea rotundata van der Werff, Ann. Missouri Bot. Gard. 78: 419. 1991. TYPE: Ecuador. Loja: Parque Nac. Podocarpus, 2900–3200 m, 29 Apr. 1987, *H. van der Werff & W. Palacios 9192* (holotype, MO-3691604; isotypes, AAU, HBG, MO-3785033, QAME).

Shrub or small tree to 10 m; twigs 5–8 mm diam., solid, slightly angular and rufous tomentose-tomentellous when young, becoming terete and glabrous with age; terminal buds rufous tomentose. Leaves alternate, 5–8 × 4.5–6 cm, broadly elliptic, smallest leaves often roundish, coriaceous, base rounded, margin plane, not

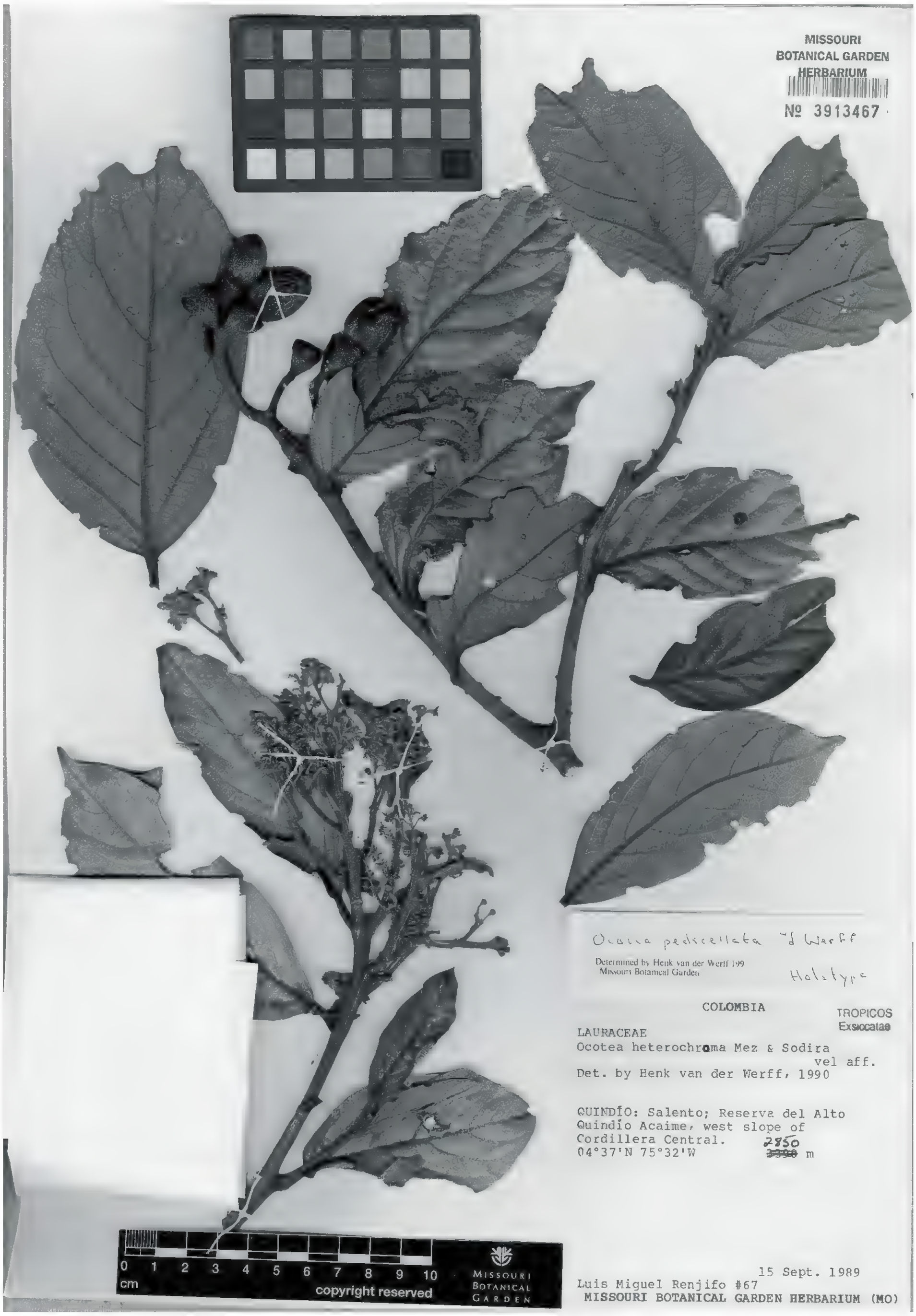

Figure 11. Holotype of *Ocotea pedicellata* van der Werff (*L. M. Renjifo 67*, MO).

thickened, apex rounded or with a short acumen, upper surface glabrous or with some rufous pubescence when young; domatia absent; midrib and veins immersed, lower surface rufous tomentose, surface entirely covered, color of the indument fading on old leaves and the tomentum wearing off, midrib and veins elevated on lower surface but tertiary venation not visible, secondary veins 4 to 6 on each side, lower 2 or 3 close together near the base of the leaf; petioles 3–6 mm, shallowly canaliculate or flat, with similar

indument as the twigs. Inflorescences axillary, 6–12 cm, rufous tomentose, paniculate-cymose or racemose when inflorescences small. Flowers perfect, 7 mm diam., pale yellow or creamy, densely pubescent, indument ferruginous tomentose, floral tube deep and gradually narrowed into the very short pedicels, these 0.2 mm, densely pubescent, tepals 6, ca. 3 mm, ovate, inner surface with some papillose pubescence near the tips, this best visible in young flowers, otherwise glabrous; stamens 9, all 4-locular, locelli arranged in 2 rows, filaments of the outer 6 stamens 0.8 mm, dorsally with a row of hairs, inner 3 stamens erect, 1.6 mm, filament pubescent as long as the anther; glands large, attached near the base of the inner filament, upper pair of the locelli lateral, lower pair extrorse; staminodia ca. 1 mm, lower part pubescent, columnar tip glabrous and swollen; pistil ca. 2.5 mm, glabrous; floral tube deep, pubescent inside. Fruits ellipsoid, 2 × 1.5 cm; cupule funnel-shaped, 1.8 cm diam., margin weakly double-margined, tepals deciduous in the fruiting stage.

Discussion. *Ocotea rotundata* can be readily recognized by its very broad leaves with a rounded base, the ferruginous indument on the leaves, and the few pairs of secondary veins. It is a relatively common species and has been collected in southern Ecuador, in the provinces of Loja and Zamora Chinchipe, at altitudes between 2500 and 3200 m. In leaf size and shape it resembles *O. umbrina*, a species from Colombia (departments Quindío and Tolima, growing at similar elevations). The Colombian species differs in floral details (inner surface of the tepals densely pubescent, filaments of stamens glabrous) and has a glaucous caste on the lower leaf surface, growing into a sizeable tree 15–30 m high (vs. to 10 m high in *O. rotundata*).

IUCN Red List category. *Ocotea rotundata* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Selected specimens seen. ECUADOR. **Loja:** Parque Nac. Podocarpus, Cerro Toledo, 4 May 1987, *H. van der Werff & W. Palacios 9321* (MO). **Zamora Chinchipe:** Parque Nac. Podocarpus, Rd. Yangana–Valladolid, just S & E of pass (Nudo de Sabanilla), 14 Mar. 1989, *B. Øllgaard 91095* (MO).

19. Ocotea stenophylla van der Werff, sp. nov. TYPE: Bolivia. La Paz: Nor Yungas, entre Chuspipata y Coroico, 16°15′S, 67°41′W, 2600 m, 13 Aug. 1991, *W. Palacios 7522* (holotype, MO-4940093; isotype, QCNE not seen). Figure 12.

Ocoteae palaciosii van der Werff similis, sed ab ea foliis angustioribus, venis majoribus immersis et floribus congestis recedit.

Trees 8 m; twigs terete to angular, 3 mm diam., solid, densely brown tomentellous; terminal buds densely brown tomentellous. Leaves 7–10 × 2–2.7 cm, alternate, narrowly elliptic, coriaceous, upper surface glabrous, lower surface densely ferruginous tomentellous, hairs short and strongly twisted, covering the surface completely, base acute, margin flat, apex acute or acuminate; domatia absent; venation immersed on the upper surface, tertiary venation not visible, midrib and secondary veins raised, tertiary venation faintly raised on the lower surface, secondary veins 6 to 8 on each side; petioles 4–6 mm, flat above, with a similar indument as the twigs. Inflorescences 2–5 cm, paniculate-cymose, densely light brown pubescent, in the axils of bracts. Flowers 4.5 mm diam., creamy yellow; pedicels ca. 1 mm, densely pubescent; tepals 6, ca. 1.5 × 0.7 mm, spreading, ultimately reflexed, at anthesis, pubescent or sparsely pubescent on outside and inner surface; stamens 9, all 4-locular, outer 6 stamens ca. 1 mm, filament 0.3 mm, with some hairs, inner 3 stamens 1.2 mm, erect, filament with some hairs and about as long as the anther; glands present at the base of the inner stamens; staminodia present, 0.6 mm, slender, distally slightly swollen, base with some hairs; pistil 2.5 mm, glabrous, style 1 mm; receptacle deep, sparsely pubescent inside, densely pubescent outside. Fruits and cupule not known.

Discussion. *Ocotea stenophylla* resembles *O. palaciosii* in the color of the pubescence of the leaves, spreading tepals, and the pubescent inside of the receptacle. The two species differ in leaf width (2–2.7 cm vs. 3–6.5 cm), venation (major veins immersed vs. impressed), and petiole length (4–6 mm vs. 12–18 mm). Their distribution is also different: *O. stenophylla* is known from Bolivia, whereas *O. palaciosii* is restricted to northern Ecuador.

The type collection for *Ocotea stenophylla* had been previously identified as *O. jelskii*, and duplicates may have been distributed under that name. *Ocotea jelskii* differs in its erect tepals at anthesis, bluntly acute to obtuse leaf apices, and a brown (not ferruginous) indument on the lower leaf surface. *Ocotea stenophylla* is known only from the flowering type collection, made in August at 2600 m altitude.

IUCN Red List category. *Ocotea stenophylla* has been assessed as Data Deficient (DD), based on IUCN (2001) criteria.

Figure 12. Holotype of *Ocotea stenophylla* van der Werff (*W. Palacios 7522*, MO).

20. Ocotea terciopelo C. K. Allen, Mem. New York Bot. Gard. 15: 75. 1966. TYPE: Venezuela. Lara: dry slopes betw. Los Quebraditos & Las Sabanetas, above Humocaro Bajo, 2430–2745 m, 8 Feb. 1944, *J. A. Steyermark 55414* (holotype, F).

Trees to 20 m; twigs sharply angular, 4–7 mm diam., solid, densely ferruginous tomentellous, be-

coming glabrous with age; terminal buds densely ferruginous tomentellous. Leaves 10–23 × 6–12 cm, alternate, broadly elliptic, coriaceous, base obtuse to acute, margin flat, apex acute to rounded, upper surface glabrous, lower surface densely ferruginous tomentellous; domatia absent; midrib immersed, secondary veins somewhat impressed and tertiary venation immersed on the upper surface, midrib and secondary veins prominently raised, tertiary venation somewhat raised on the lower surface, secondary veins 8 to 12 on each side; petioles 5–12 mm, flat above, with a similar indument as the twigs, lamina sometimes briefly decurrent on the petiole. Inflorescences in the axils of leaves, 15–23 cm, paniculate-cymose, densely ferruginous tomentellous. Flowers ca. 7 mm diam., yellow, base of the flowers gradually narrowed into the pedicel; pedicels 2–4 mm, pubescent; tepals 6, ca. 2.5 mm, spreading, densely pubescent on both surfaces; stamens 9, all 4-locular, glabrous, outer 6 stamens 1.2 mm, inner 3 stamens 1.5 mm; glands 2 at the base of the inner stamens; staminodia present, 1 mm, stipitiform, tip slightly swollen, glabrous; pistil ca. 2 mm, glabrous, receptacle deep, glabrous inside, pubescent outside. Fruits (ex descr., Allen, 1966) 2.5 × 1.5 cm; cupule disc-shaped, 1 cm high, 2 cm diam., the single margin with obscure teeth.

Discussion. *Ocotea terciopelo* is known only from a few collections in the Venezuelan Andes and adjacent Colombia. It is easily recognized by its rather large, coriaceous leaves with a ferruginous indument and its broad, flat petioles. The other Venezuelan species with ferruginous pubescence (*O. gentryi* and an incompletely known species discussed under *O. guaramacalensis*) have much smaller leaves. The single collection I have seen from Táchira (*Cuello et al. 2083*, MO) differs from the other specimens in having more numerous secondary veins and a more acute leaf base; its identification is tentative. The collection from Colombia near the border with Venezuela is sterile (*Gentry & Cuadros V. 75239*, MO), and its identification as *O. terciopelo* is also provisional. The second collection from Colombia has rather small leaves (to 11 cm) and a dark brown pubescence; however, it has the angular stems and coriaceous leaves with raised venation on the lower surface such that its identification as *O. terciopelo* is provisionally accepted. The description of the fruit and cupule is taken from Allen's description; the type photograph from F shows a detached fruit and does not show a cupule. However, a collection from Colombia (*Gentry & Cuadros 55578*, MO) has a bowl-shaped cupule 1.3 cm diam. and round fruits, 1.8 cm diam.

The common name cited by Allen is Laurel terciopelo; the common name given by *van der Werff et al. 7622* is Laurel cantarito; the wood is said to be used in house construction. The altitudinal range is from 1700 to 2600 m; flowers of *Ocotea terciopelo* have been collected in February, March, and October.

IUCN Red List category. *Ocotea terciopelo* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Selected specimens seen. COLOMBIA. **Guajira:** N slopes of Cerro del Espejo, Serrania de Perija, Venezuelan border, 30 Apr. 1987, 2430 m, *A. Gentry & H. Cuadros V. 75239* (MO). **Magdalena:** Cerro Kennedy, 2600 m, 24 Aug. 1986, *A. Gentry & H. Cuadros V. 55578* (MO). VENEZUELA. **Mérida:** El Paramito near Escuque, Aug. 1944, *Lasser 1225* (US). **Portuguesa:** Sucre, La Divisoria de la Concepción, 24 Oct. 1985, 1700 m, *H. van der Werff et al. 7622* (MO). **Táchira:** Quebrada Agua Azul, 14 km SE of Delicias, 22–23 July 1979, 2150–2300 m, *J. A. Steyermark & R. L. Liesner 118317* (MO). **Trujillo:** Boconó, Parque Nac. Guaramacal, 9–10 Mar. 2000, 2350 m, *N. Cuello et al. 2083* (MO, US).

21. Ocotea trematifera van der Werff, sp. nov. TYPE: Peru. Amazonas: Luya Distr., entre Maria y Fortaleza Kuelap, 06°25′S, 77°55′W, 2600–2900 m, 9 Apr. 2001, *H. van der Werff, R. Vasquez, B. Gray & R. Rojas 16854* (holotype, MO-6351389; isotypes, B, CANB, F). Figure 13.

Ocoteae arnottianae (Nees) van der Werff similis, sed ab ea foliis domatiis foveolaribus instructis, tepalis minoribus et inflorescentiis bene ramosis recedit.

Trees to 15 m; twigs angular, 3 mm diam., solid, densely brown tomentose; terminal buds densely brown tomentose. Leaves 2.5–5 × 1.7–2.5 cm, alternate, broadly elliptic to broadly obovate, coriaceous, base acute to obtuse, slightly reflexed to plane, margin plane, apex obtuse or abruptly acute, upper surface sparsely pubescent, but soon becoming glabrous, lower surface rusty brown tomentose, surface completely covered; domatia present as small, inconspicuous pits in the axils of secondary veins on the lower surface; midrib impressed, secondary veins and tertiary venation immersed on the upper surface, midrib and secondary veins raised, tertiary venation slightly raised on the lower surface, secondary veins 5 to 7 on each side; petioles 3–6 mm, tomentose as the twigs, flat above. Inflorescences 3–6 cm, in the axils of leaves, densely tomentose, paniculate cymose, the lateral branches evenly spaced. Flowers ca. 3 mm diam., green; pedicels 0.5–1 mm, densely pubescent; tepals six, 1.5–2 × 1–1.2 mm, erect to half erect, pubescent on the outside, less densely pubescent than the receptacle, inner surface sparsely pubes-

Figure 13. Holotype of *Ocotea trematifera* van der Werff (*H. van der Werff et al. 16854*, MO).

cent, margin papillose; stamens 9, all 4-locular, 1.2 mm, filaments very short, pubescent; glands present at the base of the inner stamens; staminodia present, 0.3 mm, stipitiform, pubescent; pistil glabrous, 2 mm, style as long as the ovary; receptacle deep, glabrous or the upper third pubescent, pubescent outside. Fruits ellipsoid, 1.5 × 1 cm; pedicel gradually thickened toward the fruit into a bowl-shaped cupule, base of the tepals present in young fruit, but not noticeable in mature fruit.

Discussion. *Ocotea trematifera* has been confused with *O. arnottiana*, having leaves of a similar size and with a similar color as the indument and with both occurring in the department of Amazonas, Peru. The two species differ as follows: small pit domatia are present in some of the leaves of *O. trematifera*, but are absent in *O. arnottiana*; tepals are shorter (1.5–2 mm vs. 2.7–3.2 mm) and erect to half erect (vs. spreading) in *O. trematifera*; and *O. trematifera* is a tree (12–15 m), whereas all collections of *O. arnottiana* are shrubs, usually less than 3 m tall, but with one collection to 6 m tall. Additionally, the peduncle of *O. trematifera* is about as long as the flower-bearing part, whereas the peduncle of *O. arnottiana* is much longer than the flower-bearing part, and the flowers are congested near the tips of the inflorescences. *Ocotea trematifera* is the only Andean *Ocotea* species with a densely pubescent lower leaf surface that has domatia, and this feature alone makes identification of this species easy. Domatia are not present in all leaves, but were found on some leaves of all (four) collections of *O. trematifera*. Usually domatia appear as axillary tufts of hairs on glabrous or sparsely pubescent leaves or depressions. In the case of *O. trematifera* it is the reverse: domatia appear as absence of hairs (small black holes) in the rusty brown pubescence. The domatia are not obvious and are easily overlooked.

All collections had been previously identified as *Ocotea arnottiana* or *O. ferruginea*, and duplicates may have been distributed under those names. The two flowering collections of *O. trematifera* were made in February and April; the altitudinal range is from 2350 to 3100 m.

IUCN Red List category. *Ocotea trematifera* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

Paratypes. PERU. **Amazonas:** Prov. Chachapoyas, Km. 408 Leymebamba–Balsas rd., 06°45′S, 77°48′W, 3000–3080 m, *D. N. Smith 6114* (MO); Luya Distr., dentro de la Fortaleza de Kuelap, 2900 m, *R. Vasquez, J. Campos & E. Teran 25464* (MO). **Cajamarca:** Prov. Jaén, distr. Pomahuaca, Caserio Amilan, 06°00′S, 79°15′W, 2350 m, *I. Shonle 165* (MO).

22. Ocotea umbrina van der Werff, sp. nov. TYPE: Colombia. Tolima: La Carbonera. 04°40′N, 75°20′W, 2750 m, 16 Mar. 1993, *S. Madriñan, S. Arango & M. Salazar 743* (holotype, MO-5293954). Figure 14.

Ocoteae pautensi van der Werff similis, sed ab ea basi foliorum rotundata et inflorescentiis brevioribus recedit.

Trees to 30 m; twigs angular, 3–6 mm diam., solid, brown tomentose, surface completely covered; terminal buds densely brown tomentose. Leaves 6–9.5 × 4–7, alternate, broadly elliptic, coriaceous, base rounded or subcordate, margin flat to recurved, apex obtuse to rounded, young leaves sparsely tomentellous, more densely so near the base, older leaves glabrous and lustrous above, lower leaf surface tomentellous, surface completely covered, indument the color of raw umber and becoming sparser on older leaves; domatia absent; midrib and secondary veins impressed, tertiary venation immersed on the upper surface, midrib and secondary veins prominently raised, tertiary venation raised and scalariform on the lower surface, secondary veins 6 to 8 on each side; petioles 4–6 mm, flat above, puberulous. Inflorescences in the axils of bracts near the tips of the twigs, 5–10 cm, densely tomentose. Flowers 5–6 mm diam., yellow; pedicels 2 mm, pubescent; tepals six, 2.5–3 × 2 mm, spreading, densely pubescent outside, inner surface pubescent; stamens 9, all 4-locular, outer 6 stamens 1.5 mm, filament glabrous or nearly so, ca. 1 mm, anther bent toward the center of the flower, inner 3 stamens ca. 1 mm, erect; glands present at their base; staminodia present, 0.6 mm, stipitiform, glabrous or with a few hairs near the base; pistil glabrous, 2.2 mm, ovary 1.7 mm; receptacle with patches of hairs inside, but these hairs disappearing in old flowers/young fruits, densely pubescent outside. Fruits ellipsoid, 2.2 × 1.7 cm; cupule funnel-shaped, to 1.5 cm high, 1.2 cm diam., tepals deciduous in the fruiting stage.

Discussion. *Ocotea umbrina*, named after the color of the indument (raw umber), is similar to *O. pautensis*; the two species share broadly elliptic leaves, impressed major veins on the upper leaf surface and this venation prominently raised on the lower leaf surface, and flat petioles. They differ in their leaf bases, which are roundish to subcordate in *O. umbrina* and shortly attenuate in *O. pautensis*, and in the inflorescence size (5–10 cm in *O. umbrina* vs. 15–20 cm in *O. pautensis*). Their distribution is also different, with *O. umbrina* known only from the Cordillera Central in Colombia and *O. pautensis* from central Ecuador.

The pubescence on the inner surface of the receptacle in *Ocotea umbrina* is patchy and disappears quickly in old flowers (when tepals and outer stamens have fallen off and the ovary starts growing in a young fruit). Flowering collections have been made in March, June, and July; the single fruiting collection dates from March. The altitudinal range is from 2700 to 3000 m.

IUCN Red List category. *Ocotea umbrina* has been assessed as Vulnerable (VU), based on IUCN (2001) criteria.

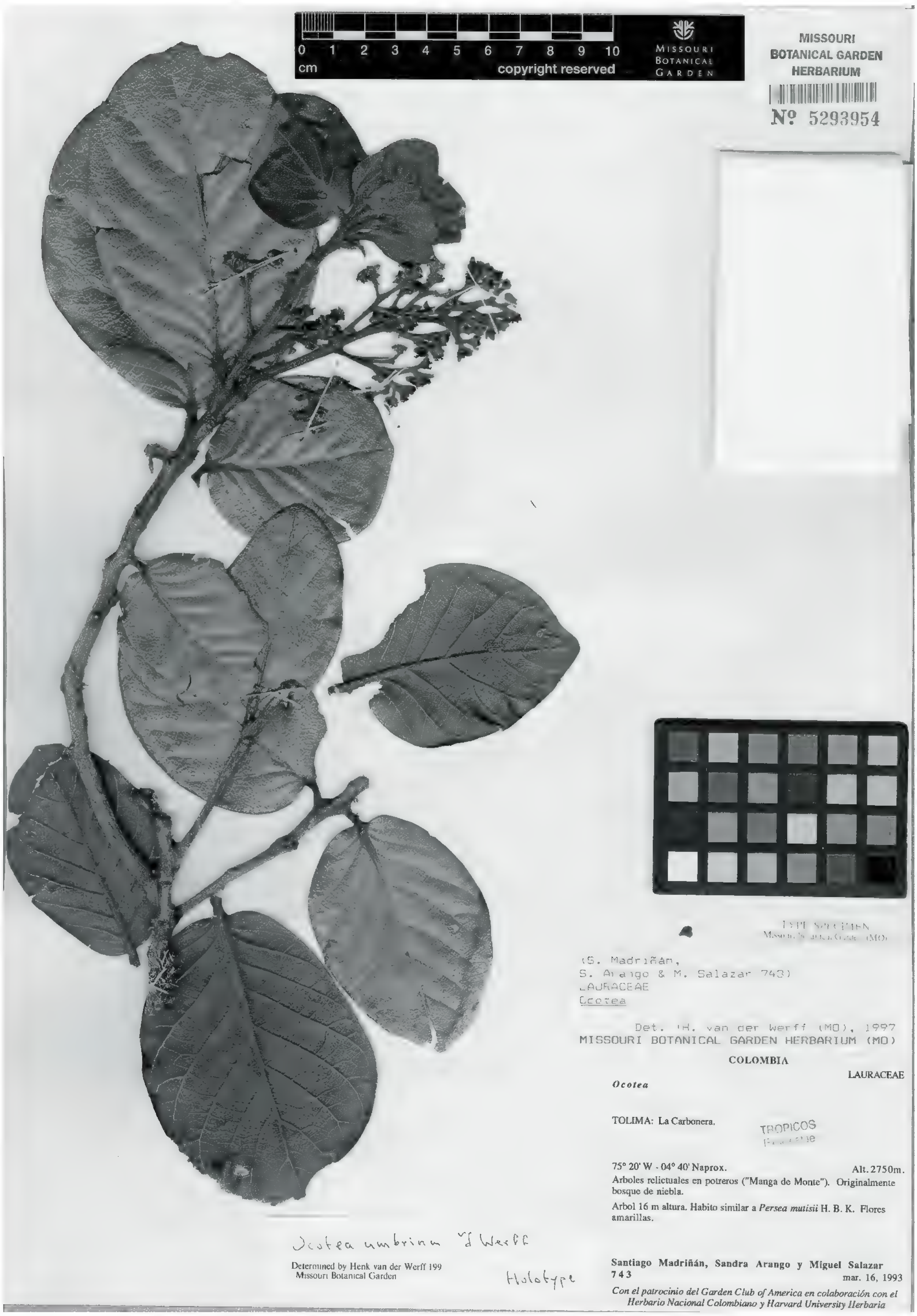

Figure 14. Holotype of *Ocotea umbrina* van der Werff (*S. Madriñan et al. 743*, MO).

Paratypes. COLOMBIA. **Quindío:** Salento, Reserva Nac. Acaime, 04°40′N, 75°30′W, 2750 m, *S. Madriñan, S. Arango & M. Salazar 722* (F, MO); Mun. de Salento, La Marina, 2700 m, *W. Vargas 9068* (MO); Salento, Reserva del Alto Quindio Acaime, 04°37′N, 75°32′W, 2760 m, *L. M. Renjifo* 128 (MO). **Tolima:** Mun. de Cajamarca camino a paramo de Valles, 3000 m, *W. Vargas 8095* (MO).

The following species was overlooked during the preparation of the manuscript.

Ocotea multinervis van der Werff, Novon 13: 353, 2003. TYPE. Peru. Piura: Prov. Morropón, Carretera entre Chalaco y San Miguel, 2000 m, 18 Oct. 1988, *C. Diaz & R. Vasquez 3030* (holotype, MO).

This species is readily recognized by its densely tomentellous lower leaf surface and the many (14 to 21) pairs of secondary veins. *Ocotea multinervis* is known with certainty from the department of Piura in Peru; the two cited collections from Ecuador and Colombia differ in having smaller leaves with an abruptly rounded base and may represent a different species. Additional collections can solve this question.

Acknowledgments. Loans from B, F, P, U, and US are gratefully acknowledged. Mike Blomberg provided the specimen scans for the figures of the new species. Gordon McPherson reviewed the key and kindly made helpful suggestions.

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Appendix 1

List of exsiccatae examined. Collections are listed alphabetically by collector, and type collections are in boldface. The numbers in parentheses correspond to the numbers of the species in the text

List of Species

1. *Ocotea andina* van der Werff
2. *O. arnottiana* (Nees) van der Werff
3. *O. benthamiana* Mez
4. *O. cardinalis* Mez
5. *O. comata* van der Werff
6. *O. gentryi* van der Werff
7. *O. glabriflora* van der Werff
8. *O. guaramacalensis* van der Werff
9. *O. heterochroma* Mez & Sodiro
10. *O. infrafoveolata* van der Werff
11. *O. jelskii* Mez
12. *O. loxensis* van der Werff
13. *O. micrantha* van der Werff
14. *O. pajonalis* van der Werff
15. *O. palaciosii* van der Werff
16. *O. pautensis* van der Werff
17. *O. pedicellata* van der Werff
18. *O. rotundata* van der Werff
19. *O. stenophylla* van der Werff
20. *O. terciopelo* C. K. Allen
21. *O. trematifera* van der Werff
22. *O. umbrina* van der Werff

Balslev 2620 (10), Beck 22268 (5), Boeke 2625 (9), Boyle 2347 (3), 3417 (3), 3418 (3).

Camp E-4808 (10), Campos 3143 (3), 5577 (10), 5607 (10), 5920 (3), 5922 (3), 6496 (3), Caranqui 655 (9), 1176 (9), 1632 (9), Castro 19564 (2), Cerna 427 (15), Ceron 28840 (10), 31980 (10), Clark 1724 (10), Cuadros 359 (10), Cuatrecasas 18942 (10), 20418 (10), 20588 (10), 21922 (10), 25824 (17), 26428 (10), Cuello 1137 (8), 2083 (20), Cueva 585 (14), Cumbicus 552 (1), 1366 (1).

Devia 649 (10), 2054 (10), Diaz 2799 (4), 10523 (3), Duque 345 (10).

Edwards 561 (16), Elleman 66560 (18).

Foster 9009 (14), Fuentes 8787 (5), 10768 (5), 10885 (5), 12246 (5), **14843** (5), 15489 (5).

Garcia-Barriga 12063 (17), Gentry 39980 (14), 40016 (14), 55578 (20), 57186 (6), 57239 (20), 64686 (6), 64688 (20), 79199 (6).

Harling **21068** (10), 23684 (18), Hartweg 1392 (3), Homeier 302 (3), 973 (1), 1416 (10), 1422 (10), 1474 (1), 1483 (3), 1511(3), Huaman 8 (1), 17 (3), 18 (3), 20 (1), 21 (3), 22 (10), 23 (10), 36 (15), 55 (10), Huertas 827 (6), Hutchinson 5535 (2).

Jaramillo 5348 (9), 7149 (10), 7686 (10), 8890 (10), 8940 (10), 8984 (9), Jelski **167** (11), **190** (11), 193 (2), **205** (11), Jørgensen 1043 (1), 1308 (10), 1328 (10), 2164 (12).

Knight 218 (10).

Lægaard 58015 (12), 58476 (10), Larsen 229 (18), Lasser 1225 (20), Leon 2183 (1), Lewis 2862 (10), Linden 715 (6), Luteyn 11018 (15), 11399 (2).

Madriñan 722 (22), 726 (17), 741 (17), **743** (22), 744 (17), Madsen 85763 (10), 86143 (10), 86179 (3), 86212 (10), 86691 (18), Mathews 1429 (2), Monteagudo 7176 (2), 7504 (14), 7581 (1), 7889 (14), 7234 (2), 7913 (14), 8077 (2), 12169 (14), Mora 138 (10), Mostacero 1603 (2).

Neill 12966 (15), 15426 (15).

Øllgaard 58382 (18), 91095 (18).

Palacios 3661 (9), 3699 (9), 3711 (3), 5272 (10), 6509 (15), 6512 (15), 6972 (10), **7522** (19), 10575 (15), **11976** (15), 12523 (3), 12594 (3), 12927 (18), Perea 880 (2), Pérez Arbeláez 8179 (6).

Renjifo 67 (17), 86 (10), 128 (22), Rojas 1532 (14), 2128 (14), 2586 (14), Rubio 2296 (10), **2302** (16).

Sanchez Vega 4566 (2), 6007 (4), Shonle 165 (21), Silverstone-Sopkin 6539 (10), Smith 2519 (2), 6114 (21), 7191 (2), **13896** (13), Stein 2718 (18), Stergios **16107** (8), 16113 (8), Steyermark 118317 (20).

Tipaz 1 (9), 10 (10), 64 (10), 85 (10), 87 (10), Triana 1022 (6).

Valenzuela 1764 (1), 8826 (1), **10133** (7), 10161 (7), H. Vargas 3352 (3), 3504 (3), W. Vargas 527 (17), 555 (10), 704 (17), 8095 (22), 9068 (22), Vasquez 25423 (1), 25434 (1), 25464 (21), 25471 (1), 26761 (11), **28546** (14), 28550 (14), 28915 (14), 30186 (2), 30388 (14), 30753 (14), 32728 (14), 34518 (14).

Weberbauer 3545 (4), Webster 29471 (3), 30597 (3), van der Werff 7622 (20), 9189 (18), 9192 (18), 9195 (18), 9245 (1), 9283 (18), 9284 (18), 9285 (18), 9321 (18), 9426 (10), 10439 (10), 10594 (10), 10595 (9), 10624 (10), 13363 (9), 10468 (10), 14745 (1), 14932 (2), 16852 (1), **16854** (21), 16855 (1), 16884 (2), 17719 (1), 18666 (14), 18670 (14), 18705 (14), 18582 (14), 19474 (15), **19600** (12), 19704 (14), **22680** (1), 22885 (14), 22954 (2), 22957 (2), 22965 (2), 22997(2), 23071 (2), 23077 (14), 23081 (14), 23202 (14), 23203 (14), 23220 (2), Wood 112 (6), Wurdack 1278 (2), 1422 (2), 1462 (2).

Young 1508 (1).

Zak 2473 (9).

A New Woody Bamboo (Poaceae, Bambusoideae) from Central Brazil, *Aulonemia xerophylla*

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Abstract. A new species of *Aulonemia* Goudot (Poaceae) is formally described here from the Distrito Federal and Goiás in central Brazil. *Aulonemia xerophylla* P. L. Viana & Filg., known from gallery forests in the Cerrado, has deflexed and coriaceous leaf blades and awnless spikelets as diagnostic characters. Descriptions and illustrations of macromorphological and anatomical characters of the new species are provided, as well as comments on its IUCN conservation status of Endangered (EN).

Resumo. Uma nova espécie de *Aulonemia* Goudot (Poaceae), nativa do Distrito Federal e Goiás, Brasil, é aqui formalmente descrita. *Aulonemia xerophylla* P. L. Viana & Filg., conhecida de matas de galeria em Cerrado no Brasil central, possui, como caracteres diagnóticos, lâminas foliares coriáceas e deflexas e espiguetas múticas. São apresentadas descrições e ilustrações de caracteres mofológicos e anatômicos da nova espécie assim como seu status de conservação, ameaçada, de acordo com os critérios da IUCN.

Key words: Arthrostylidiinae, *Aulonemia*, Brazil, Gramineae, IUCN Red List, Poaceae.

The Cerrado region, located mostly in central Brazil, is an important center of plant endemism (Oliveira & Marquis, 2002; Ratter et al., 2003). Although the diversity of bamboo species in this biome cannot be compared to what is found among the high-altitude forests of South America, conspicuous taxa, such as the typical *Actinocladum verticillatum* (Nees) McClure ex Soderstr. and *Olyra taquara* Swallen, and the endemics *Filgueirasia arenicola* (McClure) Guala, *F. cannavieria* (Silveira) Guala, *Guadua magna* Londoño & Filg., *Eremocaulon capitatum* (Trin.) Londoño, and *Merostachys filgueirasii* Send., occur in the region.

Aulonemia Goudot is a genus of woody Neotropical bamboos comprising 36 described species (Judziewicz et al., 1999), with others remaining to be described (Judziewicz, pers. comm.). The genus is distributed from Mexico to southern Brazil, and most species are found in moist, high-altitude sites. Brazilian species are distributed from the Rio Grande do Sul to Bahia, occurring principally in the Atlantic rainforest biome. Among them, only *A. aristulata* (Döll) McClure and the unusual *A. effusa* (Hack.) McClure, which resembles *Myriocladus* Swallen from the Guiana Shield and is associated with quartzite outcrops of the campos rupestres of the Espinhaço Range, are not considered endemic to the Atlantic forest biome.

During floristic studies in the Cafuringa Environmental Protection Area in Brazil's Distrito Federal, we found a distinctive woody bamboo along a gallery forest crossing the Cerrado vegetation. Its lax, paniculate synflorescence, with spikelets bearing two glumes and five to eight fertile florets, its ramification pattern with a single divergent branch, and the presence of fimbriae on the summit of its leaf sheaths are characters that include the taxon within *Aulonemia*, according to concepts of the genus from McClure (1973) and Judziewicz et al. (1999). Thereafter, while examining bamboo specimens from other Brazilian herbaria, we realized that it was recorded in the Chapada dos Veadeiros region in

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Goiás, which also falls within the cerrado phytogeographic domain.

We formally describe this new species, and include a morphological description, illustration of the principal morphological characters, and anatomical features of its leaf blade.

For anatomical studies, only the central portion of mature leaf blades was taken and fixed in 70% ethyl alcohol (Johansen, 1940). Transverse blade sections were cut using a bench microtome (Reichardt Jung AG, Heidelberg), clarified and stained with 1% safranin–alcian blue, and mounted in synthetic resin (Paiva et al., 2006). Franklin's (1945) solution was used for preparing paradermal sections. The anatomical description provided is based on the type (*Filgueiras & Graciano-Ribeiro 3705*). The descriptive terminology for leaf anatomy follows Ellis (1976, 1979).

Aulonemia xerophylla P. L. Viana & Filg., sp. nov. TYPE: Brazil. Distrito Federal: Brasília, Braslândia, APA de Cafuringa, 15°30′S, 47°50′W, pequena mata de galeria em pleno Cerrado, ca. 1100 m, 12 Apr. 2007 (fl.), *T. S. Filgueiras & D. Graciano-Ribeiro 3705* (holotype, IBGE; isotypes, BHCB, MBM, MO, RB, SP, US, UWSP). Figures 1, 2.

Species nova *Aulonemiae amplissimae* (Nees) McClure affinis, sed ab ea laminis foliaribus coriaceis reflexis lanceolatis usque ad 3.3 cm latis abaxialiter pubescentibus differt.

Caespitose bamboo, pachymorph, short-necked rhizomes; culms erect, sometimes with apices leaning on the vegetation, 1–3 m, usually covered by an ephemeral wax, more conspicuous on young shoots; midculm internodes 12–22 × 0.2–0.7 cm, hollow, thin-walled, terete, pale brown, not mottled, glabrous; nodal line horizontal, glabrous; intranodal area 0.2–0.4 cm long × 0.4–0.5 cm diam., glabrous; supranodal ridge conspicuous or not, smooth; buds ovate to ovate-lanceolate, 5–9 × 2–6 mm, glabrous, cataphylls ciliate toward the apex or on entire margin length; branch complement 1 per node, 2–20 cm, with 4 to 10 leaves. Culm and foliage leaves not differentiated; sheaths glabrous to finely pubescent, slightly keeled toward the apex, margins glabrous; auricles absent; pseudopetioles 3–7.9 × 1.5–3.2 mm, pubescent adaxially, glabrous and waxy abaxially toward the blade; fimbriae persistent, 1–4(6) mm, erect, free, waxy, rounded, typically scabrous only at the base, apex smooth, stramineous; external ligule membranous, ciliolate, ca. 0.4 mm; inner ligule membranous, ciliolate, 0.4–8 mm; blades lanceolate, 10.2–22 × 1.9–3.3 cm, coriaceous, glabrous adaxially, pubescent abaxially, deflexed, base asymmetrical, rounded, apex acuminate, margins antrorsely scabrous. Synflorescence a lax, rounded, oblong to pyramidal panicle, 21.5–27.2 × 8.8–20.2 cm; the first-order branches divergent; peduncle glabrous; pedicels 2.5–17 × 0.1–0.2 mm, glabrous. Spikelets elliptical, 0.9–1.6 × 0.25–0.45 cm, laterally compressed, glumes 2, fertile florets 5 to 8 and apical rudimentary floret 0 to 1; glume I 5.2–6.6 mm, 3- to 5-nerved, glabrous to puberulous, ciliolate toward the apex, the apex acute, usually acuminate, awnless; glume II 6.8–8.2 mm, 5- to 7-nerved, puberulous, apex acute, awnless; fertile lemma 5.8–7.5 mm, 5- to 9-nerved, purple, puberulent, ciliate, apex acute, sometimes apiculate, awnless; palea 5.2–6.8 mm, 2- to 4-nerved, not mottled, puberulent, apex notched; lodicules 3, triangular to linear-lanceolate, apex ciliate; stamens 3, anthers 2.4–4.5 mm, yellow; ovary 1.2–1.4 mm, elliptic, apex pilose, with 2 stigmas. Caryopsis not seen.

Leaf blade anatomy: *Transverse sections* (Fig. 2A–D). Leaf blade flat to slightly undulate adaxially, with ridges and furrows more pronounced toward the margins; epidermis covered by a thick cuticle on both sides, with rectangular papillose cells, silica cells, abaxial unicellular macrohairs, two to seven fan-shaped adaxial bulliform cells that can extend to 50% of the mesophyll width. Mesophyll consisting of four to five layers of arm cells adaxial to the fusoid cells and two layers on the abaxial side; intercostal sclerenchyma fibers situated laterally to the bulliform cells and opposite to them, on the abaxial side of the blade. Vascular bundles of first and second orders slightly projected abaxially, with double sheath and sclerenchyma extensions toward adaxial and abaxial sides; midrib with a complex vascular system, with a first-order and two lateral third-order bundles, surrounded by sclerenchyma fibers and an incomplete parenchyma sheath.

Paradermal sections (Fig. 2E, F). Adaxial epidermis consisting of up to six rows of cells on the costal zone and up to 13 in the intercostal zone; costal zone composed of short cells (silica cells) and long cells; intercostal zone composed of silica cells, long cells, bulliform cells, stomata, bicellular microhairs and rarely prickles; long cells with sinuous walls and a single row of rounded papillae; silica cells narrow and prominent, with smooth or crenate walls; stomata present only in the intercostal zones, overarched by ca. eight papillae, its subsidiary cell cupuliform; bulliform

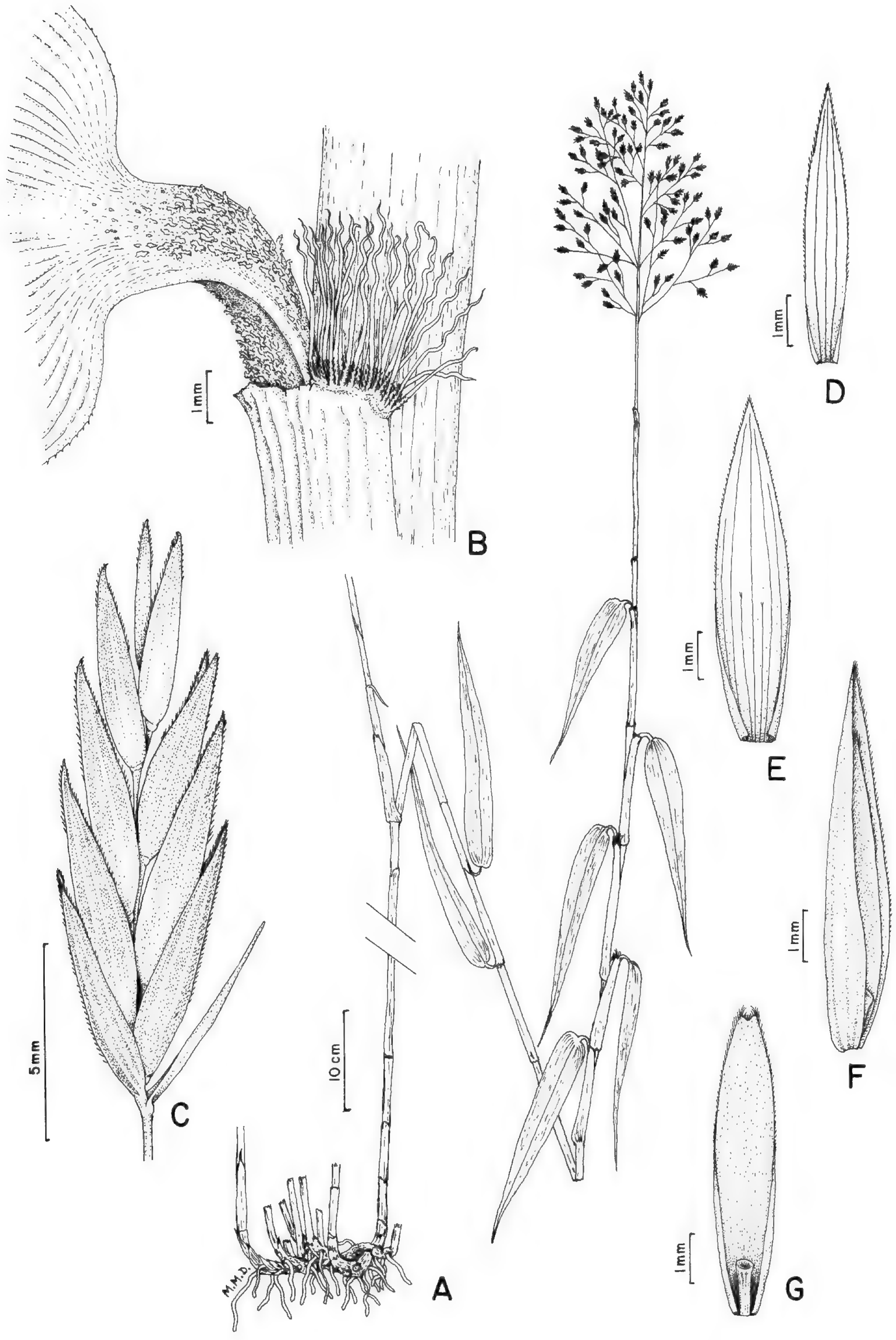

Figure 1. *Aulonemia xerophylla* P. L. Viana & Filg. —A. General habit, showing rhizomes and a flowering culm. —B. Detail of the leaf ligular region, with conspicuous fimbriae. —C. Spikelet. —D. Glume I. —E. Glume II. —F. Fertile floret. —G. Palea. Drawn from the holotype *T. S. Filgueiras & D. Graciano-Ribeiro 3705* (IBGE).

cells in rows of two to three, quadrangular to cuplike; bicellular microhairs with the apical cell shorter and with rounded apex. Abaxial epidermis consisting of up to eight rows of cells in the costal zone and up to 10 in the intercostal zone; costal zone composed of silica cells, long cells, bicellular microhairs, short to midsized unicellular macrohairs with sharp apices, apparently with random disposition; intercostal zone

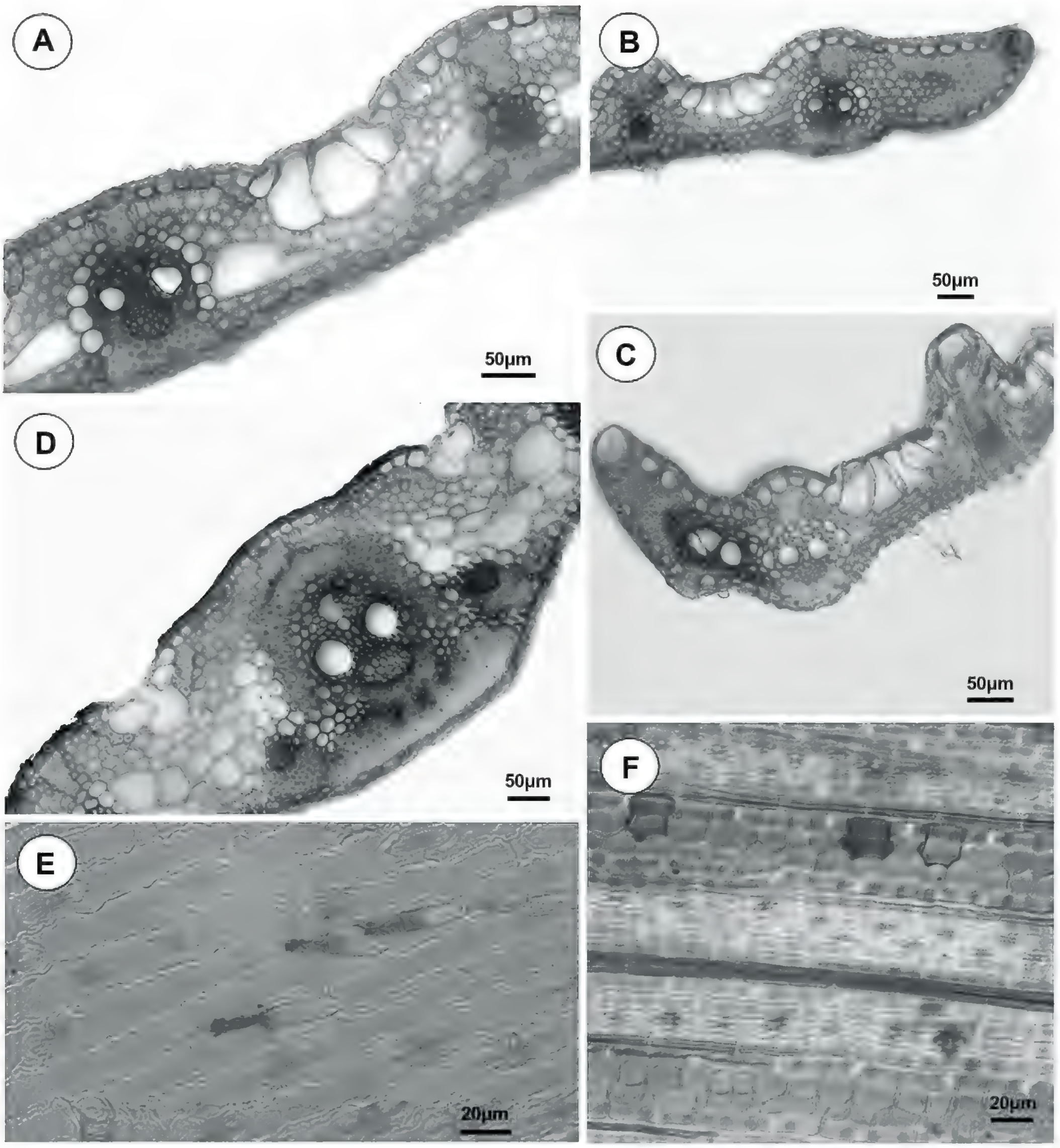

Figure 2. *Aulonemia xerophylla* P. L. Viana & Filg. —A. Transverse section of leaf blade, showing the slightly undulate, adaxial surface. Intercostal fibers are located laterally to the bulliform cells and abaxially are shown the arm cells, fusoid cells, and vascular bundles of first and second orders. —B, C. Detail of the unequal blade margins showing abundant fibers. —D. Midrib, with the first-order vascular bundle flanked by two small, third-order vascular bundles. —E. Adaxial surface with bulliform cells and stomata evident in the intercostal zone, in paradermal view. —F. Abaxial surface in paradermal view; note the bicellular microhairs and stomata. Micrographs taken from the type, *T. S. Filgueiras & D. Graciano-Ribeiro 3705* (IBGE).

composed of stomata, silica cells, long cells with one or two rows of papillae and macrohairs.

IUCN Red List category. The Cerrado biome is one of the 25 regions in the world (biodiversity hotspots) where conservation strategies are a priority (Myers et al., 2000) because of the high diversity of endemic species and an increasing level of environmental destruction (Oliveira & Marquis, 2002; Klink & Machado, 2005). According to IUCN Red List categories and criteria for evaluating species conservation status (IUCN, 2001), *Aulonemia xerophylla* may be considered Endangered (EN): B1a,c(iv)+2a,c(iv); C2(b). The species is known only from two localities in riparian forests, where it is not abundant. In addition, only the type locality is situated in an environmentally protected area, APA Cafuringa, within the Distrito Federal.

Considering that the agrostological flora of the Distrito Federal and the surrounding Cerrado areas have been intensively studied in the last decades (Filgueiras, 1988, 1991; Rodrigues-da-Silva & Filgueiras, 2003), we assume that this species is very rare in the region, although specific attempts to find it in other locations remain appropriate.

Etymology. The specific epithet refers to the unusual coriaceous leaf blade of this species, which seems to be an adaption to the typical xerophytic conditions of the surrounding Cerrado region.

Discussion. *Aulonemia xerophylla* is unique within *Aulonemia* due to the combination of its distinctive coriaceous leaf blades and the awnless spikelets. At first glance, it can be mistaken for *A. amplissima*, which is from dwarf forests above 1500 m in the Serra da Mantiqueira and the Serra do Mar in southeastern Brazil, due to its lax panicles with awnless spikelets. However, *A. xerophylla* has coriaceous, deflexed, and lanceolate leaf blades up to 3.3 cm wide, and *A. amplissima* has chartaceous, reflexed or not, and oval-lanceolate leaf blades up to 11.5 cm wide.

Aulonemia effusa from the campos rupestres of Minas Gerais and Bahia also has coriaceous leaf blades but is quite different from *A. xerophylla*. The leaves in *A. effusa* bear blades that are typically erect and almost sessile with an inconspicuous pseudopetiole, as in *Myriocladus* species. In *A. xerophylla* the blades are deflexed and the pseudopetioles are 3–7.9 mm. In *A. effusa* the spikelets are awned, whereas in *A. xerophylla* they are awnless.

Aulonemia xerophylla is the second native species of the genus recorded from Distrito Federal or Goiás. *Aulonemia aristulata* also occurs in Cerrado riparian forests in the region, but it is easily distinguished by its thinner culms (not more than 4 mm wide), scandent habit, and spikelets with conspicuous awns.

Intercostal fibers and refractive papillae, present in *Aulonemia xerophylla*, are diagnostic characters of subtribe Arthrostylidiinae (Soderstrom & Ellis, 1986; Ruiz-Sanchez et al., 2008). However, characters not common in this subtribe were recorded for *A. xerophylla*, such as stomata that are regularly distributed on both abaxial and adaxial surfaces of the leaf blade and complex vascularization of the midrib. Leaf blade midribs with a complex vascular organization, which has long been a typical feature of the subtribe Guaduinae (Soderstrom & Ellis, 1986), has been also recorded in *A. setosa* (Londoño & L. G. Clark) P. L. Viana & Filg. (Viana et al., 2011). Although the presence of stomata on both sides of the blade is considered to be a character of the Guaduinae, this distribution is indeed quite common in Arthrostylidiineae species, but the stomata are restricted to a marginal region of the blade above the abaxial marginal green stripe (Santos-Gonçalves, 2005; Viana et al., 2011). In *A. xerophylla*, the stomata are distributed across the entire adaxial surface of the leaf blades. This demonstrates the necessity of sampling additional species to evaluate those characters that present reliable taxonomic importance within the Bambusoideae.

Paratype. BRAZIL. **Goiás:** Alto Paraíso, Estrada Alto Paraíso/Nova Roma, adjacências da ponte sobre o ribeirão São Ricardo, 20 Feb. 1991, *D. Alvarenga, B. A. S. Pereira, B. M. T. Walter & F. C. A. Oliveira 731* (CEN, IBGE).

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Valid Publication of *Croton dinghuensis* (Euphorbiaceae) and *Helicia yangchunensis* (Proteaceae), Two Species Endemic to Guangdong, China

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ABSTRACT. Two names proposed by H. S. Kiu, *Croton dinghuensis* (Euphorbiaceae) and *Helicia yangchunensis* (Proteaceae), were originally described from Guangdong, China, but were invalidly published because the author failed to specify the repository herbarium of the types. These names are validated by designating *G. L. Shi 2763* (IBSC) as the holotype of *C. dinghuensis* H. S. Kiu and *Zhanjiang Expedition 03261* (IBSC) as the holotype of *H. yangchunensis* H. S. Kiu.

Key words: China, *Croton*, Euphorbiaceae, *Helicia*, Proteaceae.

Two invalidly published names, *Croton dinghuensis* H. S. Kiu and *Helicia yangchunensis* H. S. Kiu in the Euphorbiaceae and Proteaceae families, respectively, have come to our attention while working on the checklist of endemic taxa from China. When these names were proposed by Kiu (1995, 1998), he indicated that the types were deposited at the South China Botanical Garden (IBSC) and Dinghushan Biosphere Reserve (IBSD) for *C. dinghuensis*, and at IBSC and Zhongshan University (SYS) for *H. yangchunensis*, but failed to indicate or distinguish the repository herbaria for the two holotypes. Thus, the contravention of Article 37. 7 of the International Code of Botanical Nomenclature (McNeill et al., 2006) invalidates the names. Unfortunately, these oversights were not discovered in the taxonomic treatment for the updated English edition of *Flora of China*, Vols. 5 and 8 (Kiu & Weston, 2003; Li et al., 2008). To enable the formal use of these names, here we explicitly designate the holotypes and herbaria of deposit to validate these names. Note that Kiu (1995, 1998) did include Latin diagnoses and descriptions, and this fulfills the requirement for validation under Article 36.1. Ascription, according to Article 46.2, is to H. S. Kiu as the author of *C. dinghuensis* and *H. yangchunensis*.

1. Croton dinghuensis H. S. Kiu, sp. nov. TYPE: China. Guangdong: Zhaoqing, Dinghu, Shuiken, in valley forest, 250 m, 20 May 1966, *G. L. Shi 2763* (holotype, IBSC; isotype, IBSD).

The validating description and diagnosis were previously published by Kiu (1998: 101–103).

Croton dinghuensis is morphologically most similar to *C. laniflorus* Geiseler, sharing features such as glabrous inflorescences, filamentous or absent female petals, and lanceolate sepals in female flowers. *Croton dinghuensis* differs by having papery leaves, glabrous on both surfaces, and with flat, disciform glands at the base of the leaf blade midvein. This contrasts with *C. laniflorus*, which has thinly leathery leaves abaxially with scurfy stellate hairs, petioles with a pair of cupular glands at the apex, but no glands on the leaf blade or midvein. *Croton dinghuensis* also resembles *C. laevigatus* Vahl, sharing subulate stipules, papery leaves, and an ovary with densely stellate hairs. However, *C. dinghuensis* has glabrous inflorescences and calyces in both male and female flowers. These contrast with the dense and appressed stellate indument of the calyx in both male and female flowers and the persistently pubescent inflorescences observed in *C. laevigatus*. Capsules are similar in size (1 cm in diam.), but are subglobose and sparsely stellate in *C. dinghuensis* and obovoid or trigonous and densely pubescent in *C. laevigatus* (Kiu, 1998; Li et al., 2008).

Habitat and distribution. *Croton dinghuensis* is known only from Guangdong Province in southeastern China. The species has a limited distribution, growing in forests in limestone regions at altitudes from 100 to 250 m.

2. Helicia yangchunensis H. S. Kiu, sp. nov. TYPE: China. Guangdong: Yangchun Co., Sanjiatong, 700 m, 28 May 1957, *Zhanjiang Exped. 03261* (holotype, IBSC [barcode] 0009706; isotypes, IBK, IBSC, SYS).

The validating description and diagnosis were previously published by Kiu (1995: 110–111). In the process of confirming the type specimens, an

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additional specimen with the same collector, number, and date was found in the Guangxi Institute of Botany (IBK). It is confirmed as part of the original gathering for the type and is included here as an additional isotype.

Helicia yangchunensis is similar to *H. formosana* Hemsl.; both taxa are trees that share a dense, rust-colored pubescence on young branchlets and inflorescences, and a woody pericarp. *Helicia yangchunensis* differs by having a smaller perianth, ca. 1.4–1.5 cm, with shorter, appressed indument (pilosulose) versus the perianth 1.5–2 cm and pilose in *H. formosana*. Mature leaf blades are abaxially pilose along the midvein but otherwise glabrescent in *H. yangchunensis*, and the blade margins are entire. In *H. formosana*, mature leaf blades are abaxially pilose along all veins, not just the midvein, and the blade margins are toothed. Inflorescences are smaller in *H. yangchunensis*, only 7–8 cm, but are much longer, 10–24 cm, in *H. formosana*.

Habitat and distribution. *Helicia yangchunensis* is known only from Yangchun Co., in Guangdong, China, growing in forests, hilly slopes, and often along streams at altitudes from 600 to 700 m.

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A New Species of *Stephania* (Menispermaceae) from South Guangxi, China

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Abstract. A new species, *Stephania novenanthera* Heng-Chang Wang (Menispermaceae), from Xia-shi, Ping-xiang County, Guangxi Province, China, is described and illustrated. The new species is similar to the sympatric species *S. kuinanensis* H. S. Lo & M. Yang, *S. kwangsiensis* H. S. Lo, and *S. micrantha* H. S. Lo & M. Yang by several characters, such as the tuberous root, the deltoid to rounded leaves, and the compound, umbelliform cymes. *Stephania novenanthera* differs from all species in *Stephania* Lour. in China by its nine anthers.

Key words: China, Guangxi, IUCN Red List, Menispermaceae, *Stephania*.

The genus *Stephania* Lour. (Menispermaceae) was established with the descriptions of *S. longa* Lour. and *S. rotunda* Lour. in 1790 (Diels, 1910). Comprising ca. 60 species (Forman, 1986; Luo, 1996; Luo et al., 2008), this is a relatively large genus in the cosmopolitan dioecious family Menispermaceae (Cronquist, 1981; Kessler, 1993). Members of this genus have triporate pollen (Harley & Ferguson, 1982) and a relatively small hippocrepiform seed and embryo (Ortiz et al., 2007), and reported species have a unitegmic ovule (Soejima, 1990). The genus is distributed in tropical and subtropical Asia and Africa, with some species in Oceania (Kessler, 1993). The plants are herbaceous perennial vines with a large, subterranean woody caudex and are often noted for their medicinal value with diverse alkaloids (Wet & Van Wyk, 2008). There are 37 species recognized in China, of which 30 are endemic (Luo et al., 2008). Specimens of the new species were originally collected in Xia-shi, Ping-xiang County, Guangxi Province, China, at the border area between southwestern China and northern Vietnam.

Stephania novenanthera Heng-Chang Wang, sp. nov. TYPE: China. Guangxi: Ping-xiang County, Xia-shi, 450–650 m, 21 Mar. 2006, *A. P. Meng 20060002* (holotype, HIB). Figure 1.

Haec species *Stephaniae kwangsiensi* H. S. Lo, *S. kuinaensi* H. S. Lo & M. Yang et *S. micranthae* H. S. Lo & M. Yang affinis, sed a hac petiolis brevioribus, ab illis duabus florum staminatorum petalis intus eglandulosis, ab omnibus staminibus 9 differt.

Vines deciduous, dioecious, and herbaceous, usually 2–3 m or longer, glabrous; roots tuberous, sometimes irregularly so, brown, with many prominent lenticels; stems somewhat lightly twining, light gray to light brown when dry. Petioles 2–8 cm, shorter or subequal in length to the leaf blade, slightly swollen at both ends; leaves peltate, deltoid or triangular-rounded to rotund, usually 8–14 × 8–14 cm, papery, grayish brown when dry, both blade surfaces glabrous, base subtruncate to rounded, margins entire, apex mucronate or slightly obtuse, palmately 8- or 9-veined, raised abaxially. Inflorescences as compound, umbelliform cymes, axillary or on short axillary branches with reduced leaves. Staminate inflorescences on axillary branches; peduncle 3–10 cm; umbellate peduncles usually three or four, 2–3 cm in length; ca. 20 to 30 flowers per inflorescence; cymelets slightly congested; staminate flowers on pedicels ca. 0.5 mm long. Staminate flowers with 6 sepals, in 2 whorls of 3 sepals in each whorl, spatulate, glabrous, 3–3.5 × 2.5 mm, petals 3 to 6, fleshy, equally long as wide, 1.5–2 × 1.5–2 mm, imbricate, subconchiform, apex acute, glabrous, lacking glands; synandrium peltate, 0.5–0.7 mm, with 9 (occasionally 10) connate anthers; anthers dehiscing transversely. Pistillate inflorescences subcapitate, cymelets almost sessile on axillary branches; peduncles 4–8 cm, usually equal to or slightly longer than petioles; pedicels of the umbellate portion 1.5–2 mm, pedicels of the cymelets and flowers very short, 0.5–1 mm. Pistillate flowers with 1 sepal, obovate-

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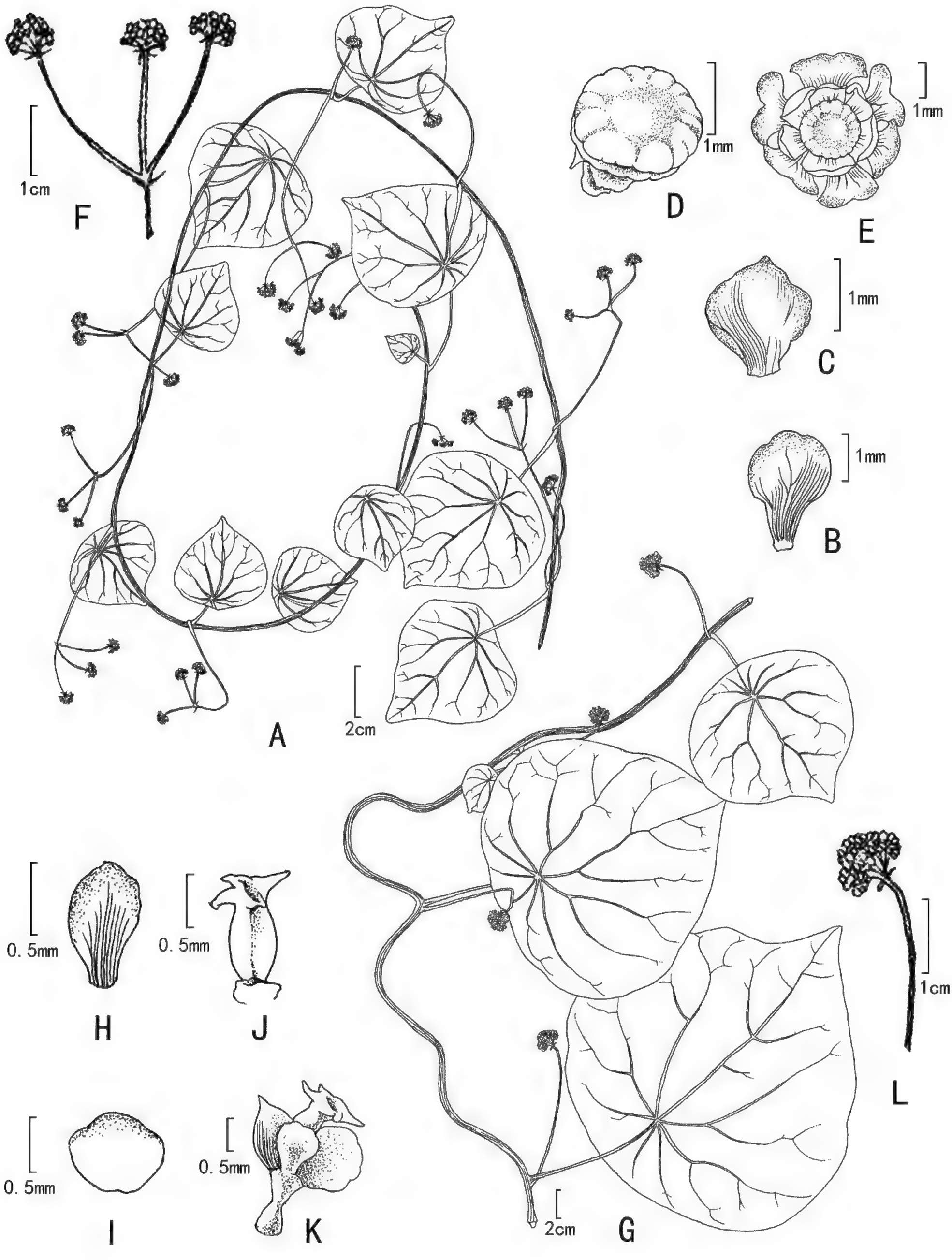

Figure 1. *Stephania novenanthera* Heng-Chang Wang. A–F. Portion of staminate plant and flowers. —A. Fertile habit. —B. Sepal from the external whorl. —C. Petal from the staminate flower. —D. Synandrium dissected from flower. —E. Apical view of intact staminate flower. —F. Inflorescence of the staminate plant. G–L. Portion of pistillate vine and flowers. —G. Fertile habit. —H. Sepal from the external or internal whorl. —I. Petal from the pistillate flower. —J. Ovary dissected from flower. —K. Lateral view of pistillate flower. —L. Inflorescence of the pistillate plant. A–F drawn from the holotype *A. P. Meng 20060002* (HIB); G–L drawn from the paratype *A. P. Meng 20060001* (HIB).

elliptic to spatulate, ca. 0.7–0.9 × 0.5–0.8 mm; petals 2, orange-yellow, conchiform, 0.6–1 × 0.6–1 mm; ovary unicarpellous, orthotropous, ca. 1 × 2 mm; stigma crestlike, with 4 lobes; staminodes absent. Drupe red, obovoid; endocarp 5.5–6.5 × 4–5.5 mm.

Distribution and habitat. *Stephania novenanthera* is distributed in shrublands or forest margins on limestone mountains, at altitudes of 450–650 m in southern Guangxi Province, China.

IUCN Red List category. *Stephania novenanthera* was discovered during an expedition and is currently known only from three localities in Xia-shi, Ping-xiang County, Guangxi Province. Without further investigation, there is insufficient information to estimate the conservation status for the new species, and its conservation status is assessed here as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Stephania novenanthera* was observed in flower in February to May and in fruit at the beginning of April.

Etymology. The epithet of the new species refers to its distinctive, larger number of anthers (nine), as compared to the other species of the genus, which usually have three to six anthers.

Discussion. *Stephania novenanthera*, *S. kwangsiensis* H. S. Lo, *S. kuinanensis* H. S. Lo & M. Yang, and *S. micrantha* H. S. Lo & M. Yang are roughly distributed in the same region, in southwestern Guangxi Province (Luo, 1996). *Stephania novenanthera* is similar to *S. kuinanensis*, *S. kwangsiensis*, and *S. micrantha* in characters that include the tuberous root, the shape of the leaves as deltoid to rounded, and the inflorescences as compound, umbelliform cymes. The new species differs from *S. kwangsiensis* and *S. kuinanensis* mainly in the staminate flowers having nine anthers (vs. six or seven or four, respectively) and the subconchiform petals without glands inside. The perianth varies from two whorls of sepals that are oblanceolate to obovate in the inner whorl, with two glands basally evident in *S. kuinanensis*. The two sepal whorls in the staminate flowers of *S. kwangsiensis* range from spatulate-oblanceolate to obovate to broadly ovate, with the inner whorl densely papillate internally, with two large glands. *Stephania novenanthera* differs from *S. micrantha* in its petioles usually being shorter than the leaf blades (vs. the petioles being longer or much longer in *S. micrantha*), the number of palmate veins being usually eight or nine (vs. being less than nine or 10 in *S. micrantha*), and in having nine anthers (vs. six in *S. micrantha*).

Both staminate and pistillate individuals of *Stephania novenanthera* have been transplanted to South China Botanical Garden in several instances from the type locality. We observed that plants of the new species maintain the same morphological characters as in the wild. Furthermore, they normally produce seeds, and the number of anthers in the next generation has been maintained as consistently nine, occasionally 10, but not fewer as noted for other Chinese species in *Stephania*.

Paratypes. CHINA. **Guangxi:** Ping-xiang, Xia-shi, 450–650 m, 21 Mar. 2006, *A. P. Meng 20060001* (HIB); Guangzhou, South China Botanical Garden, 5 Apr. 2012, *S. P. Wang 20120032* (IBSC).

Stephania novenanthera is distinguished from other sympatric *Stephania* species in Guangxi by the key below.

KEY TO FOUR *STEPHANIA* SPECIES IN SOUTH GUANGXI, CHINA

1a. The internal whorl of sepals in staminate flowers with 2 large glands inside 2
  2a. Stamens with 4 connate anthers in the synandrium; petals conchiform; leaf blades with 10 or 11 palmate veins, 5 or rarely 7 veins oriented upward and the others downward ..... *S. kwangsiensis*
  2b. Stamens with 6 or 7 connate anthers in the synandrium; petals broadly cuneate; leaf blades with 9 or 10 palmate veins, 5 veins oriented upward and the others downward ..... *S. kuinanensis*
1b. Petals of staminate flowers lacking internal glands 3
  3a. Stamens with 6 connate anthers in the synandrium; petals conchiform, apex truncate or subtruncate; leaf blades with 9 or 10 palmate veins, 5 veins oriented upward and the others downward; petioles slender (4–10 cm), usually longer or much longer than the leaf blade (3.5–7.5 cm) ..... *S. micrantha*
  3b. Stamens with 9 (occasionally 10) anthers in the synandrium; petals subconchiform, apex acute; staminate flowers; leaf blades with 8 or 9 palmate veins, 3 veins oriented upward and the others downward; petioles (2–8 cm) usually shorter than the leaf blade (8–14 cm) ..... *S. novenanthera*

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Erratum

The print date in NOVON 22(2) is 30 November 2012; however, the 28 November 2012 posting of the PDF to BioOne constitutes the effective date of publication.

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Lectotypifications in *Calyptranthes* (Myrtaceae) from the Neotropics

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Abstract. The taxonomic study of *Calyptranthes* Sw. (Myrtaceae) in preparation of an annotated checklist, has required a thorough literature survey, extensive visits to herbaria worldwide, and analysis of type collections online. Resulting information has indicated the necessity of lectotypification for several species, nine of which are addressed here: *C. fastigiata* O. Berg, *C. glabrescens* Krug & Urb., *C. kiaerskovii* Krug & Urb., *C. longifolia* O. Berg, *C. multiflora* Poepp. ex O. Berg, *C. obovata* Kiaersk., *C. pteropoda* O. Berg, *C. ruiziana* O. Berg, *C. schiedeana* O. Berg, and *C. tetraptera* O. Berg.

Key words: *Calyptranthes*, Myrtaceae, Neotropics.

Calyptranthes Sw. (Myrtaceae) is distinguished morphologically from the other, closely related genera of *Myrcia* DC. (sensu Lucas et al., 2011) in having calyx lobes fused into a calyptra (McVaugh, 1968). The 266 accepted species of *Calyptranthes* have a Neotropical distribution with a high level of endemism (World Checklist of Selected Plant Families, 2013).

As sampled to date (Lucas et al., 2011), *Calyptranthes* is a monophyletic group within the *Myrcia* clade; this sample, however, is relatively limited, comprising only six taxa for *Calyptranthes*. DNA-based phylogenetic study is ongoing, and in order to assemble as wide a sample as possible for phylogeny and monography, problems with species delimitation must be solved. This aids taxonomic identification, particularly for rare species or those known only from their type collections. To clarify these and other taxonomic problems and to prepare for the eventual monography of the group, an annotated checklist of the genus is in preparation, based on a herbarium specimen database currently containing ca. 3000 reliably named, georeferenced *Calyptranthes* collections.

As part of this exercise, it is necessary to resolve several typification issues. The Berlin herbarium (B) housed the majority of *Calyptranthes* types for the 49 species described by Otto Berg during and after his preparation of Myrtaceae for *Flora Brasiliensis* (1857–1859) as well as many of those collections cited by Krug and Urban in preparation for their treatment of Caribbean species. These species descriptions, as was common at the time, generally do not designate a single type collection, instead listing different collections or citing collections distributed to multiple herbaria. The requirement of modern taxonomy to lectotypify or neotypify (McNeill et al., 2012) is therefore a major taxonomic challenge further compounded by the destruction of the Berlin herbarium during World War II (Stafleu & Cowan, 1981). Furthermore, several names are nomenclaturally ambiguous and unplaced (World Checklist of Selected Plant Families, 2013) because of the unknown whereabouts of their types. This paper provides lectotypification of nine species of *Calyptranthes* required for one or more of the reasons given above, and one of these names is newly synonymized.

Materials and Methods

Taxonomy used herein follows the World Checklist of Selected Plant Families (2013) unless stated otherwise. Digital images of all material seen for this study are available on request from the first author; most are currently available from JSTOR (2011).

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Information regarding the locations of collections or top sets of particular botanists is taken from Taxonomic Literature 2 (TL2 Online, 2012). When there were no obvious reasons to select one syntype or collection number over another, the better distributed collection was selected. Collections of the following herbaria were visited: BM, E, G, K, M, US, W; the following type collections were available online (separate from JSTOR): C, F, NY, RB, S, U; collections were checked on our behalf by the respective curators of the following herbaria: GOET, HAL, MA, MEL. As suggested by the referees we are using "Sello," instead of the spelling "Sellow," within the text when referring to the German botanist and collector.

1. **Calyptranthes glabrescens** Krug & Urb., Bot. Jahrb. Syst. 19: 596. 1895. TYPE: E Cuba, May 1889, *Eggers 5404* (lectotype, designated here, M; isolectotypes, A, K).

The name *Calyptranthes glabrescens* was based on the single collection *Eggers 5404*; however, the holotype was destroyed at B. Although Eggers's top set of the collection is known to be housed at the Copenhagen herbarium, no material from this collection number was found there. Three isotypes were found at other herbaria. Considering that Urban distributed the duplicates himself after he studied them (Stafleu & Cowan, 1981), it is very likely he saw the three isotypes above. The Munich sheet is selected over the others because it bears Urban's handwriting identifying the collection as *C. glabrescens*, whereas the K sheet is identified as *C. syzygium*, an illegitimate name, and the sheet housed at A has not been identified. The M sheet is a complete specimen; it was closely studied by the authors and corresponds well to the morphological data in the protologue.

2. **Calyptranthes kiaerskovii** Krug & Urb., Symb. Antill. 1: 43. 1898, replacement name for *Calyptranthes obovata* Krug & Urb. Bot. Jahrb. Syst. 19: 600. 1895, nom. illeg. superfl., non *Calyptranthes obovata* Kiaersk., Enum. Myrt. Bras.: 38. 1893. TYPE. British Virgin Islands. Tortola, 1895, *H. Eggers 3217* (lectotype, designated here, C).

Krug and Urban (1898) described this species, citing the specimen *Eggers 3217* as the type collection, but under the illegitimate name *Calyptranthes obovata* Krug & Urb.; this epithet was already occupied by Kiaerskov for a different taxon from Brazil, accepted in the *Enumeration of Brazilian Myrtaceae* (Kiaerskov, 1893: 38). Three years after their publication, Urban corrected this error with his new name *C. kiaerskovii* Krug & Urb. (Urban, 1898: 43), the holotype of which was housed in Berlin and has since been destroyed. The only known extant material is an isotype at C (*Eggers 3217*), which is here designated as the lectotype.

3. **Calyptranthes longifolia** O. Berg, Fl. Bras. 14(1): 46. 1857. TYPE: Peru, "In silvis primaevis secundus fluvium Amazonum in prov. Solimoes, Brasilia," s.d., *[E. F.] Poeppig 2162* (lectotype, designated here, W; isolectotypes, G, HAL, P, W).

Berg (1857) noted only the collection *Poeppig 2162* in the protologue without indication of the herbarium. Poeppig's main type collection set was at W, but he sent duplicates to Berlin where Berg was based (Stafleu & Cowan, 1981). The B sheet is destroyed, and we, therefore, decided to select the collection from W because Poeppig's top set is housed there and because the sheet label corresponds with the citation for locality by Berg (1857).

4. **Calyptranthes multiflora** Poeppig ex O. Berg, Fl. Bras. 14(1): 42–43. 1857. TYPE: [Brazil. Prov. Amazonas?:] "*flumen Teffe, Prov. Solimoes*," 1831, *[E. F.] Poeppig 2684* (lectotype, designated here, W; isolectotypes, G, F [3]. F neg. 68695, HAL, MICH, NY, P).

Berg noted two collections syntypic to one another in the 1857 protologue: *Poeppig 2684* and *Spruce s.n.* (Brazil, Para, "barra do Rio Negro," F, K, M, OXF, W). The Poeppig collection is selected as the lectotype because it is a better specimen, has more complete material, was widely distributed, and presents more information on the label.

5. **Calyptranthes obovata** Kiaersk., Enum Myrt. Bras. 38–39, tab. IV k–m. 1893. TYPE: Brazil. Rio de Janeiro, Feb. 1889, *A. M. Glaziou 17662* (lectotype, designated here, C; isolectotypes, BR, C, F, G, K, NY, P, R-R000008940, US).

Kiaerskov cited two collections by Glaziou, numbered as 17662 and 16992 (BR, C, F not seen, G) in his protologue for *Calyptranthes obovata*, and both were found broadly distributed in several herbaria. Because the author was based at the Copenhagen herbarium, we believe the lectotype should be chosen between one of the two collections housed there. Both collections are equally good

candidates as lectotype; however, the first collection is selected, because it is more widely distributed.

6. Calyptranthes pteropoda O. Berg, Fl. Bras. 14(1): 47. 1857. TYPE: Brazil, Minas Gerais: "in prov. Minas Geraes," 23 Jan. 1846, *Widgren 549* (lectotype, designated here, S as S03-699; isolectotypes, BR, HUEFS, S, SP, US).

The top set of Widgren's collections was part of the Sonder herbarium now housed at MEL where *Widgren 549* was not found. The principal herbaria holding Sello duplicates were searched, including R, with a search by the curator for a Sello collection identified as *Calyptranthes pteropoda* proving fruitless. Therefore, we have here chosen the US duplicate of *Widgren 549* as the lectotype because it was the only sheet that both authors had the opportunity to analyze against the protologue. The SP sheet was studied only by the first author, and all the remaining sheets were only confirmed online.

7. Calyptranthes ruiziana O. Berg, Linnaea 27: 22. 1855. TYPE: Peru, s.d., *H. Ruiz L. 5105* (lectotype, designated here, US-41315 [barcode] 00033831; isolectotype, MA, MA photo at F-029480).

The decision to select the lectotype from the US herbarium was based on the greater certainty that this collection, with only the name of "Ruiz" on an ex Berlin herbarium label, was the material seen by Berg (1855). The collection in MA that has the names "Ruiz et Pavon" was apparently sent directly to Madrid from Peru and has no evidence of Berg's handwriting.

8. Calyptranthes schiedeana O. Berg, Linnaea 27: 28. 1855. TYPE: Mexico. Hacienda de la Laguna, Aug. 1829, *C. J. W. Schiede s.n.* (lectotype, designated here, HAL0089752; isolectotypes, NY00386752).

As previously mentioned, Berg's Myrtaceae type collection and the top set of Schiede's collections were housed at B; all are now destroyed. Two further duplicates of an unnumbered Schiede collection annotated as *Calyptranthes schiedeana* and bearing Berg's handwriting were found at HAL and NY. The HAL collection is identified as holotype on JSTOR, but this is unlikely, firstly because both the species author and the collector of the type specimen were based in Berlin, and secondly because Berg did not indicate the herbarium in the protologue. However, here we choose the HAL collection as lectotype because it is a good specimen, complete and corresponding to *C. schiedeana*.

9. Calyptranthes tetraptera O. Berg, Fl. Bras. 14(1): 53. 1857. TYPE: Brazil. Minas Gerais, s.d., *H. L. Sello s.n.* (lectotype, designated here, K; isolectotype, BM).

The collection used by Berg to describe this species is destroyed. Two Sello collections identified as *Calyptranthes tetraptera* were found. However, the collection at BM bears an original identification as *C. rotundifolia,* whereas the K collection is clearly identified as *C. tetraptera* and bears Berg's handwriting. There is one remaining syntype, *Widgren s.n.*, cited by Berg, but this collection was not located at either MEL or R.

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Lectotypification of *Ranunculus cabrerensis* (Ranunculaceae)

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ABSTRACT. Typification of the endemic Iberian species *Ranunculus cabrerensis* Rothm. is discussed. A specimen at MA from the exsiccatae for the *Plantae Hispanie Boreali-Occidentalis* (Rothmaler, 1934) is designated lectotype for this endemic Iberian species.

Key words: Ranunculaceae, *Ranunculus*, Spain.

Werner Rothmaler published his "Species novae vel nomina nova florae hispanicae" where he described the taxon "*Ranunculus cabrerensis* Rothmaler nov. sp. ... Ex affinitate *R. parnassifolii* L., a quo differt habitu robustiore, foliis utrinque lanatis, petiolis lanatis, rostro carpelli longiore spiram formante" (1934: 148). In the same work, Rothmaler also noted that the taxon is better considered a geographical variant of the *R. parnassiifolius* complex: "Est forma geographica et melius *R. parnassiifolius* L. ssp. *R. cabrerensis* Rothm. nominanda" (1934: 148). The use of a binary combination ("*R. cabrerensis*") instead of an infraspecific epithet ("*cabrerensis*") is not admissible under Article 24.4 of the International Code of Nomenclature (ICN; McNeill et al., 2012), and although the name is validly published, it needs to be altered to the proper form: *R. parnassiifolius* subsp. *cabrerensis*. Similarly, the name was accepted at infraspecific rank by Küpfer (1974) when he studied the alpine buttercups of *R. parnassiifolius*, a polyploid complex belonging to *Ranunculus* sect. *Ranuncella* (Spach) Freyn (Ranunculaceae), which is widespread and distributed throughout south-central mountains in Europe.

A relevant issue is that Rothmaler (1934) simultaneously proposed two different names—*Ranunculus cabrerensis* and *R. parnassiifolius* subsp. *cabrerensis*—for the same taxon. According to Article 34.2 of the ICN, these alternative names are validly published because their publication was effective before 1 January 1953. Based on recent investigations on the molecular, cytogenetic, and morphological characterization of the complex *R. parnassiifolius* (sensu Küpfer, 1974), we have found many arguments that support the distinction of *R. parnassiifolius* subsp. *cabrerensis* from *R. parnassiifolius*, with an independent recognition at species level (cf. Cires et al., 2009a, 2009b, 2010; Cires & Fernández Prieto, 2012).

Exsiccatae for Rothmaler's *Plantae Hispanie Boreali-Occidentalis* are located in the Madrid herbarium (MA), as noted in the protologue for *Ranunculus cabrerensis*, as "n. 130." This collection number for Rothmaler appears on two sheets at MA, but there is no in sched. distinction between the two in Rothmaler's hand. Both sheets were annotated by Gonzalo Nieto Feliner in 1983 as "Material Tipo," although neither was further distinguished for type. The first sheet (MA-40508, <http://plants.jstor.org/specimen/ma40508>) includes a fruiting plant with cordate leaves (at upper left of sheet), among seven leafy fragments, and corresponds well to the taxonomic concept because the fruits provide precise diagnostic characters to distinguish *R. cabrerensis* from the rest of the taxa of *R. parnassiifolius*. The other sheet (MA-40509, <http://plants.jstor.org/specimen/ma40509>) is similar, with three flowering plant fragments among the seven on the sheet.

Taking into account the latest evidence toward relationships within *Ranunculus parnassiifolius* complex, and following Article 9.2 of the ICN (McNeill et

al., 2012), the name *R. parnassiifolius* subsp. *cabrerensis* is herein lectotypified.

Ranunculus parnassiifolius L. subsp. **cabrerensis** Rothm., Bol. Soc. Esp. Hist. Nat. 34: 148. 1934. *Ranunculus cabrerensis* Rothm., Bol. Soc. Esp. Hist. Nat. 34: 148. 1934. TYPE: Spain. León: Part. Ponferrada, Sierra Cabrera, in glareosis regiones nivei montium Sierra Cabrera, prope Lago de La Baña, 2000 m.s.m., 8 Aug. 1933, *W. Rothmaler 130* (lectotype, designated here, MA-40508, digital image; isolectotype, MA-40509, digital image).

In addition to this, the plants described as *Ranunculus parnassiifolius* subsp. *muniellensis* Bueno, Fern. Casado & Fern. Prieto (Bueno Sánchez et al., 1992: 365) should be considered a subspecies of *R. cabrerensis*, as demonstrated in recent studies (see Cires & Fernández Prieto, 2012), where the new combination was validly published, according to Article 33.4 of the ICN as *R. cabrerensis* Rothm. subsp. *muniellensis* (Bueno Sánchez, Fern. Casado & Fern. Prieto) Fern. Prieto & Cires (Cires & Fernández Prieto, 2012: 136).

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Eysenhardtia byei (Leguminosae, Papilionoideae), una Especie Nueva del Noroeste de México

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Abstract. *Eysenhardtia byei* Cruz Durán & M. Sousa, a new species from the northwest of Mexico, is described and illustrated. This new taxon is similar to *E. orthocarpa* (A. Gray) S. Watson var. *orthocarpa* and *E. polystachya* (Ortega) Sarg., but differs in the leaflets having revolute margins and oblique to subcordate bases (vs. flat and obtuse to semicordate), the stipels being shorter than the petiolules (vs. equal or longer), and the petals being less than twice the length of the calyx (vs. double or more), and its restricted distribution in the zone of barrancas or canyons in the states of Chihuahua and Sonora (vs. an expanded distribution).

Resumen. Se describe e ilustra *Eysenhardtia byei* Cruz Durán & M. Sousa, una especie nueva restringida a la parte noroeste de México. Este nuevo taxón es similar a *E. orthocarpa* (A. Gray) S. Watson var. *orthocarpa* y a *E. polystachya* (Ortega) Sarg., sin embargo, difiere de estas en que presenta folíolos con márgenes siempre revolutos y bases claramente oblicuas a subcordadas (vs. bases obtusas a ligeramente cordadas), las estipelas más cortas que los peciólulos, los pétalos no son el doble o más de la longitud del cáliz (vs. el doble o más), y por su distribución en los estados de Chihuahua y Sonora, en zona de barrancas (vs. amplia distribución).

Key words: Chihuahua, *Eysenhardtia*, Leguminosae, México, Papilionoideae, Sonora, IUCN Red List.

El género *Eysenhardtia* Kunth (Leguminosae, Papilionoideae) comprende árboles o arbustos con hojas imparipinnadas glanduloso-punteadas, inflorescencias en racimos terminales, flores con hipanto reducido, pistilo glandular o eglandular y fruto indehiscente con una semilla (Pennell, 1919; Lang & Isely, 1982). Este género incluye 12 especies y dos variedades con distribución restringida al área fitogeográfica de las leguminosas mexicanas (Cruz Durán, 2006). En la taxonomía de *Eysenhardtia*, los caracteres más informativos son el número de folíolos, la relación entre el largo de las estipelas y los peciólulos, y el largo de la corola y el cáliz, el tipo de inflorescencias, la posición de las legumbres (ascendentes o reflejas), y en menor grado la forma de la semilla, la distribución geográfica y la fenología (Cruz Durán, 2006).

Durante la revisión del material botánico del género *Eysenhardtia* en el Herbario Nacional de México (MEXU), se detectaron ejemplares de las regiones norteñas mexicanas de Batopilas y Urique en Chihuahua y en Yecora, Sonora, en la denominada zona de barrancas. Con base en estos ejemplares, estas zonas se caracterizan por presentar tipos de vegetación que varían de acuerdo al gradiente altitudinal; así a los 1700 m generalmente domina el bosque de *Quercus* L., a medida que se desciende a los 1500 m, domina vegetación de pino-encino y a los 800 m se da una asociación de bosque de pino con selva baja. Así mismo, para Lebgue et al. (2005) la vegetación de las barrancas varía desde los bosques de encino en combinación con algunas especies de pino a 2000 m de altitud, donde dominan *Q. arizonica* Sarg., *Q. toumeyi* Sarg., *Q. oblongifolia* Torr., *Pinus leiophylla* Schiede ex Schltdl. & Cham., *P. engelmannii* Carrière, pasando por los matorrales de huizaches (*Acacia farnesiana* (L.) Willd.) a los 250 ó 300 m, y los bosques de mauto (*Lysiloma divaricatum* (Jacq.) J. F. Macbr.) para llegar hasta los bosques ribereños de higuera (*Ficus petiolaris* Kunth, *F. pertusa* L. f., y *F. cotinifolia* Kunth), de guamuchil (*Pithecellobium dulce* (Roxb.) Benth.) y de tempisque (*Sideroxylon tepicense* (Standl.) T. D. Penn.), presentes a las orillas de los ríos Batopilas y Urique.

Así los especímenes antes mencionados mostraron similitudes con *Eysenhardtia orthocarpa* (A. Gray) S. Watson var. *orthocarpa* y *E. polystachya* (Ortega)

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Sarg. Sin embargo, estas muestras presentan caracteres únicos que apoyan el reconocimiento de la especie nueva que a continuación se describe.

Eysenhardtia byei Cruz Durán & M. Sousa, sp. nov. TIPO. México. Chihuahua: Mpio. Batopilas, on rd. to La Bufa, just N of La Bufa, 19 May 1985 (fl.), *J. Grimes, M. Lavin & R. Scott 2869* (holotipo, MEXU; isotipos, NY, TEX). Figura 1.

Haec species *Eysenhardtiae orthocarpae* (A. Gray) S. Watson var. *orthocarpae* et *E. polystachyae* (Ortega) Sarg. similis, sed a hac stipellis quam petiolulo brevioribus, inflorescentia racemosa (nec paniculata) atque pistillo longiore (6–6.5 vs. 5.6–6 mm); ab illa partibus vegetativis juvenilibus sicut inflorescentia dense albo-villosis, foliolis ad basem obliquis subcordatisve (nec obtusis) margine revoluto, stipellis longioribus ([0.5–]0.7 vs. 0.3–0.5 mm), vexillo breviore (6–7 vs. 7.5–8 mm) atque semine breviore latioreque (ca. 5 × 2.5 vs. 6–7 × ca. 2 mm); ab ambabus petiolulo longiore (1–1.5 vs. 0.5–1 mm), vexillo calycis duplo longitudinem non attingente, stylo recto atque semine ambitu ligulato distinguitur.

Árboles pequeños de 3–5 m de alto o arbustos de 1.5–2.5 m de alto; corteza fisurada en rectángulos; tronco ca. 0.15 m diám.; ramillas blanco-seríceas. Hojas (4.5–)5–8.4(–9.4) cm, con pecíolos, raquilla y folíolos blanco-villosos; estípulas 3–4 mm, lanceoladas, el haz rojizo, el envés seríceo; pecíolos (0.35–)0.4–0.7 cm, acanalados; folíolos (15 a)17 a 35(a 49), oblongos, con base oblicua a subcordada, (7–)7.6–15 × 2.8–5.2 mm, haz y envés villosos, venas secundarias evidentes, margen revoluto, ápice obtuso con mucrón evidente, vena media hendida, peciólulos 1.0–1.5 mm, acanalados en el haz; estipelas (0.5–)0.7 mm, rojizas (más cortas que los peciólulos); raquilla acanalada en el haz, envés villoso y con algunas glándulas de color pajizo. Inflorescencias terminales (un racimo por ramilla), (4.5–)6.5–11.5(–15) cm con pubescencia blanco-villosa abundante. Flores 6–7 mm, blancas a crema pálido; pétalos membranáceos (menos del doble de la longitud de cáliz); pedicelo ca. 1 mm, pronto recurvado, blanco-pubescente, brácteas hasta 1 mm, cimbiformes, cafés, envés blanco-villoso; cáliz 3–4 × ca. 2 mm, recto, villoso, con costillas evidentes, dientes deltados (en algunos casos apiculados); estandarte 6–7 × 2.5–3 mm, oblongo, emarginado, uña ca. 1 mm; ala ca. 6.5 × 1.5 mm, uña ca. 1 mm; quilla ca. 6.5 × 1.5 mm, uña ca. 1.5 mm; androceo ca. 5 mm, parte unida hasta ca. 3 mm, anteras ca. 0.5 mm; pistilo 6–6.5 mm, glabro, no exerto, estigma verde; ovario ca. 1 mm; estilo ca. 5 mm, completamente recto, con la glándula anaranjada en el doblez, cerca del estigma. Legumbres 9–12 × 2.5–3.8 mm, oblongas, reflejas, de color pajizo con algunas glándulas en la parte distal, con márgenes engrosados, el cáliz persistente y con abertura dorsal de hasta 2 terceras partes; semillas ca. 5 × 2.5 mm, una por fruto, café a negras, liguladas, ocupando la mitad de la vaina.

Distribución y hábitat. *Eysenhardtia byei* es común en áreas abiertas y orillas de caminos. En la región de Batopilas, Chihuahua, se presenta en bosques de encino con elementos espinosos, en encinares de barranca, así como en la transición de bosque tropical caducifolio y bosque de pino-encino. Mientras que en Yecora, Sonora, se le encuentra en el fondo de cañones, en selva baja con *Pinus oocarpa* Schiede & Schltdl., vegetación de galería, bosques de pino-encino y encinares. Así mismo, se asocia con *Bursera laxiflora* S. Watson, *Loeselia mexicana* (Lam.) Brand., *Pachycereus pecten-aboriginum* (Engelm. ex S. Watson) Britton & Rose, *Plumeria rubra* L., *Quercus tuberculata* Liebm., *Yucca madrensis* Gentry, y especies de *Acacia* Mill., *Acer* L., *Agave* L., *Buddleia* L., *Cupressus* L., *Dasylirion* Zucc., *Ipomoea* L., *Montanoa* Cerv., *Opuntia* Mill., *Perityle* Benth., y *Tithonia* Desf. ex Juss., en altitudes de (760 a)1200 a 1802 m.

Categoría de la lista Roja de UCNI. *Eysenhardtia byei* se considera como una especie Vulnerable (VU; UICN, 2001), pues aunque se encuentran poblaciones relativamente abundantes, estas constan de arbustos pequeños y generalmente restringidas a los taludes de caminos de terracería.

Fenología. Esta especie florece de mayo a julio y fructifica de septiembre a octubre.

Etimología. El epíteto específico está dedicado al Dr. Robert A. Bye Boettler (1947–), botánico estadounidense, estudioso de la etnobotánica y taxonomía de plantas útiles de México. El Dr. Bye ha efectuado y dirigido expediciones de campo en las sierras y barrancas del oeste de Chihuahua, México, por al menos los últimos 40 años. Sus observaciones de campo, fotografías y recolecta de alrededor de 15,000 ejemplares botánicos, han sido la base para la realización de más de 100 publicaciones que documentan la flora, el uso e historia botánica de la sierra Tarahumara. Así mismo, se ha desempeñado como profesor e investigador en la Universidad de Colorado y la Universidad Nacional Autónoma de México, donde actualmente reside.

Nombre común y usos. Se le conoce como "palo dulce" o "bauhuio", y por la dureza de la madera, se usa como material de construcción (Dr. Toutcha Lebgue, Universidad Autónoma de Chihuahua, pers. com.).

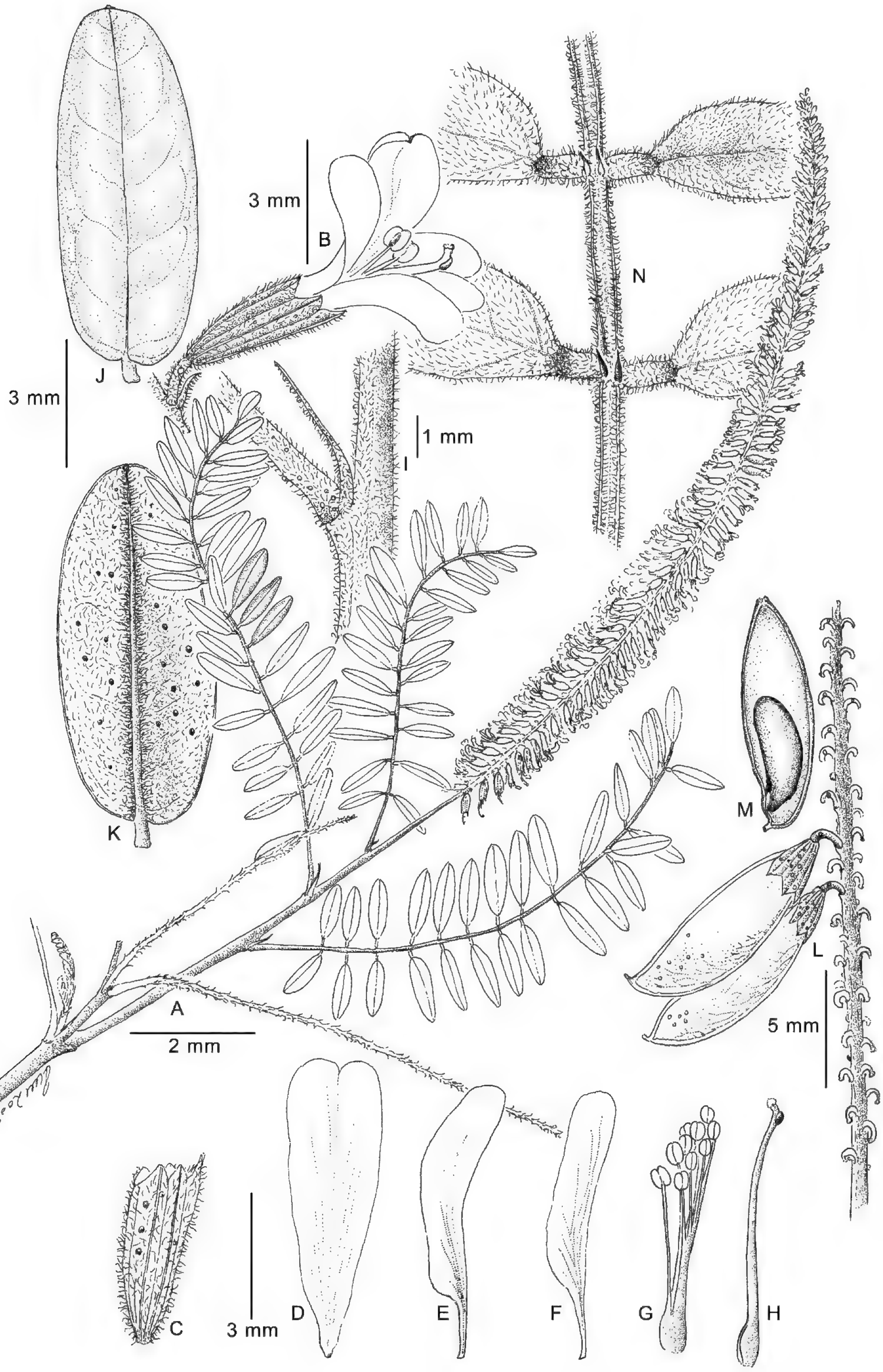

Figura 1. *Eysenhardtia byei* Cruz Durán & M. Sousa. —A. Rama con inflorescencia. —B. Flor y bráctea. —C. Cáliz. —D. Estandarte. —E. Ala. —F. Pétalo de la quilla. —G. Androceo. —H. Pistilo. —I. Estípula. —J. Folíolo, haz. —K. Folíolo, envés. —L. Frutos. —M. Semilla. —N. Estipelas. A–I y N, dibujados con base en el holotipo *Grimes et al. 2869* (TEX); J y K, dibujados con base en el paratipo *Bye et al. 35941* (MEXU); L y M, dibujados con base en el paratipo *Bye et al. 35958* (MEXU).

Cuadro 1. Comparación entre *Eysenhardtia byei* y especies afines.[1]

	E. orthocarpa var. *orthocarpa*	*E. polystachya*	*E. byei*
Hojas, largo (cm)	5–11.5	3–10.5	(4.5–)5–8.4(–9.4)
Folíolos			
Número	21 a 37	23 a 61	(15 a)17 a 35(a 49)
Tamaño (mm)	9–15 × 4–7	3.5–15 × 1.5–4	(7–)7.6–15 × 2.8–5.2
Base	obtusa	obtusa a ligeramente cordada	oblicua a subcordada
Margen	aplanado	revoluto	revoluto
Peciólulo (mm)	0.5–1	0.5–1	1–1.5
Estipelas (mm)	0.3–0.5	0.5–1.2	(0.5–)0.7
Estipelas/Peciólulos, relación largo	más cortas	igual o más largas	más cortas
Inflorescencias			
Largo (cm)	4–12	4–11.5	(4.5–)6.5–11.5(–15)
Tipo	racimo	panícula	racimo
Cáliz (mm)	3–4	2.5–3.5	3–4
Estandarte			
Largo (mm)	7.5–8	6.6–7.6	6–7
El doble o más del doble de la longitud del cáliz	si	si	no
Pistilo (mm)	(4.5–)5–6.5	5.6–6	6–6.5
Estilo	glandular, recto a ligeramente curvo	glandular o eglandular, curvo	glandular, recto
Legumbre (mm)	12–14	11–13	9–12
Semilla			
Forma	oblonga	obovada a lanceolada	ligulada
Tamaño (mm)	6–7 × 2	5–6.7 × 2–2.3	5 × 2.5

[1] Las medidas listadas en el cuadro corresponden al largo de la estructura, a menos de que se indique lo contrario.

Los habitantes en las riveras de los ríos Verde, Urique, Batopilas, Chinipas, Mayo y Yaqui le han dado a esta especie valor medicinal, alimenticio, forrajero y combustible; así mismo en esta región se le conoce como "palo azul", "palo dulce" (*Bye et al. 36142*, FCME, MEXU) y "sipari". Los tarahumaras recolectan las hojas tiernas para consumirlas en calidad de quelites, así mismo las ramas tiernas son un buen forraje para ganado caprino, sin embargo en el oeste de Chihuahua el uso más común es contra afecciones del riñón. Debido a que los tallos de algunos ejemplares, alcanzan hasta los 25 cm en diámetro, la especie es muy apreciada en la construcción y como combustible (Pennington, 1980; Bye, 1982, 1986).

Discusión. *Eysenhardtia byei* difiere de *E. polystachya* por presentar un menor número de folíolos (≤ 49 vs. ≤ 61), estipelas más cortas que los peciólulos ([0.5–]0.7 mm vs. 0.5–1.2 mm), peciólulos más largos (hasta 1.5 mm vs. hasta 1 mm), base del folíolo claramente oblicua a subcordada (vs. ligeramente cordada), las inflorescencias siempre son racimos terminales, solitarios y ligeramente más largos, de hasta 15 cm (vs. varios racimos terminales que adoptan un arreglo a modo de panícula de no más de 11.5 cm).

Si se considera la relación entre la longitud de los pétalos y el cáliz, en *Eysenhardtia polystachya* los pétalos son siempre más del doble de la longitud de cáliz (cáliz 2.5–3.5 mm, pétalos 6.6–7.6 mm), mientras que en la especie nueva los pétalos no son más del doble de la longitud del cáliz (cáliz 3–4 mm; pétalos 6–7 mm). En cuanto a distribución, *E. polystachya* es un taxón de amplia distribución, mientras que *E. byei* está restringida a los estados de Chihuahua y Sonora, en zonas de barranca.

En comparación con *Eysenhardtia orthocarpa* var. *orthocarpa*, *E. byei* presenta un mayor número de folíolos, hasta 49 (vs. hasta 37), la base del folíolo es oblicua a subcordada (vs. obtusa), con margen revoluto (vs. aplanado), los pétalos no son más del doble de la longitud del cáliz, pues el cáliz mide 3–4 mm y los pétalos 6–7 mm (vs. pétalos con el doble de la longitud del cáliz, es decir 3–4 mm y 7.5–8 mm), presenta abundante pubescencia blanco-villosa en las partes jóvenes, así como en las inflorescencias (Cuadro 1). Considerando su distribución, de acuerdo con Felger et al. (2001) y Cruz Durán (2006), esta variedad se encuentra también en Arizona, Sonora y Chihuahua, sin embargo debe puntualizarse que ésta no es simpátrica con la nueva especie. Así mismo, a *E. orthocarpa* var. *tenuifolia* J. M. Lang se le puede encontrar en Sonora, pero únicamente en las regiones cercanas a Hermosillo.

Paratipos. MÉXICO. **Chihuahua:** Mpio. Batopilas, N side of barranca de Batopilas, ca. 6 km S of Quirare, 27.13347° N, 107.5778° W, 21 Oct. 2008 (fr.), *R. Bye, E. Linares & V. Morales 35958* (MEXU); N side of barranca Batopilas, betw. río Batopilas Bridge & Quirire, 27.08° N, 107.34° W, 31 May. 1980 (fl.), *R. Bye 9719* (TEX); Mpio. Urique, W side of Barranca de Urique, Km. 42.5 of rd. from Bahuichivo (Km. 0) to Urique (Km. 53), S of cerro de Gallo, 27.2496° N, 107.9337.8° W, 1720 m, 19 Oct. 2008 (fr.), *R. Bye, E. Linares & V. Morales 35941* (MEXU); mirador cerro Gallego, camino Bahuachivo-Urique, Km. 40, 27.23435° N, 107.94066° W, 2014 m, 22 Sep. 2009 (estéril), *R. Bye, D. Gernandt & S. Cristians 36142* (FCME, MEXU); Oeste de Urique, camino a Mesa de Arturo, 27.21889° N, 107.92928° W, 1032 m, 23 Sep. 2009 (fr.), *R. Bye, D. Gernandt & S. Cristians 36151* (FCME, MEXU); Mpio. Batopilas, W of La Bufa, betw. arroyo Bakosiaki & arroyo San Fernado, W of La Bufa on S side of Barranca de Batotopilas, 7 June 1973 (fl.), *R. Bye 4019* (MEXU); Mpio. Batopilas, S of Quirare, 28 Oct. 1973 (fr.), *R. Bye 5653* (MEXU); Mpio. Batopilas, on N side of Barranca de Batopilas, on La Bufa–Quirare rd., 31 July 1977 (fl.), *R. Bye 7776* (MEXU); Mpio. Guachochi, bridge over río Urique along Creel-Guacochi rd., along margin of river & slopes, 19 Oct. 1980 (fr.), *R. Bye 10027* (MEXU); Mpio. Arroyo Hondo, 11.5 km E of Kípur, 4 km W of Chihuahua border & Sonora 16, 28°26′34″N, 108°32′26.5″W, 28 May 1996 (fl.), *A. L. Reyna, T. R. Van Devender, V. W. Steimann, C. Lindquist, W. Trauba & N. Plotkin 96–269* (MEXU); Mpio. Ocampo, Parque Nac. Cascada Basaseachi, S edge of park, 108°17′N, 24°4′W, 5.3 km by rd. below Cruz Verde, 16 km S of Huajumar-Ocampo rd., 5.25 km by rd. above river, 25 May 1994 (fl.), *R. Spellenberg & R. Miller 10249* (MEXU). **Sonora:** Rio Maycoba at Mex. 16 (20.5 km W of Maycoba, 28.6 km E. Yecora), 28°22′30″N, 108°45′30″W, 1200 m, 5 May 1995 (fl.), *T. R. Van Devender & A. L. Reina G. 95–442* (NY, TEX); 26 May 1998 (fl.), *T. R. Van Devender, A. L. Reyna, G. W. Trauba, D. J. Pinkava, R. P. Rebman, J. A. Emmett, A. M. Salywon & A. Flores 98–649* (CAS); Mpio. Maycoba, W of río Maycoba, Méx 16, Km. 300.6, 28.39725°N, 108.79618°W, 1776 m, 20 Sep. 2009 (fr.), *R. Bye, D. Gernandt & S. Cristians 36121* (FCME, MEXU, MO); Mpio. Yecora, Arroyo Santa Ana, 1 km al SO de Santa Ana de Yecora, 28°22′40″N, 109°9′42″W, 27 May 1996 (fl.), *A. Búrquez, L. Varea, T. R. Van Devender & A. L. Reyna 96–204* (MEXU); Mpio. Yecora, 19 km al O de Yecora, carr. Cd. Obregón, 27 Sep. 1983 (fr.), *R. Tenorio, R. Torres & E. Torrecillas 4579* (MEXU); carr. México 16, Km. 262.2, 28.37782°N, 109.04568°W, 1776 m, 19 Sep. 2009 (fr.), *R. Bye, D. Gernandt & S. Cristians 36107* (FCME, MEXU).

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Four New Species of *Anisotes* (Acanthaceae) from Madagascar

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Abstract. Four species of *Anisotes* Nees (Acanthaceae) are described from northern and west-central Madagascar: *A. hygroscopicus* T. F. Daniel, Letsara & Martín-Bravo, *A. perplexus* T. F. Daniel, Letsara & Martín-Bravo, *A. subcoriaceus* T. F. Daniel, Letsara & Martín-Bravo, and *A. venosus* T. F. Daniel, Letsara & Martín-Bravo. A key to the six species of the genus known from Madagascar, all of them endemic to the island, is provided. Morphological features previously unknown in the genus are noted for *A. hygroscopicus* and *A. venosus* (hygroscopic trichomes on seeds), *A. subcoriaceus* (2-colporate, pseudocolpate pollen lacking insulae), and *A. perplexus* (2-pororate pollen). None of these species can be treated with certainty in any of the currently recognized sections of *Anisotes*. Data pertinent to the conservation status of each species are provided.

Key words: Acanthaceae, *Anisotes*, IUCN Red List, Madagascar.

Anisotes Nees is included in subfamily Acanthoideae, tribe Justicieae, where it forms part of a grade of Old World relatives of *Justicia* L. (McDade et al., 2000; Daniel et al., 2007). The genus can be characterized by the combination of its strongly bilabiate corollas with ascending cochlear aestivation, relatively short corolla tube (corolla tube:overall corolla length up to 0.56, but usually 0.33 or less), rugulate upper lip, and lower lip that is usually recoiled; androecium of two stamens and no staminodes; and bithecous anthers with thecae mostly subequally to unequally inserted. *Anisotes* is morphologically similar to *Justicia*, and may not be distinct from it because each of these characteristics can be found among the ca. 700 currently recognized species of the latter genus.

Baden (1981a) recognized 19 species of *Anisotes* from tropical and southern Africa, Madagascar, and tropical Arabia. Baden (1981b, 1984) also treated three species from tropical eastern and southern Africa in the morphologically similar genus *Metarungia* Baden. One of these was subsequently discovered to occur in western Africa (Darbyshire et al., 2008). Vollesen (2010) recognized 24 species in *Anisotes*, those previously treated in both *Anisotes* and *Metarungia*, the sole species previously treated in *Chlamydostachya* Mildbr., and a newly recognized species that had been treated as a subspecies of *A. dumosus* Milne-Redh. by Baden (1981a). Baden (1981a) recognized six sections of *Anisotes* based primarily on differences in inflorescences, bracteolar venation, and pollen sculpturing.

Two species have been reported from Madagascar, *Anisotes divaricatus* T. F. Daniel, Mbola, Almeda & Phillipson and *A. madagascariensis* Benoist (Daniel et al., 2007), both endemic to coastal or near coastal sandy regions in the dry, spiny forests and thornscrub of the southwestern sector of the island nation. Benoist, an expert on Acanthaceae of Madagascar, annotated several specimens among the Malagasy collections at P as probable undescribed species of *Anisotes*, but did not publish names for these taxa (Daniel et al., 2007). Recent collections augment those known to Benoist and reveal the existence of other new species of *Anisotes* from Madagascar. Additional specimens at P were identified by Benoist as *Anisotes* but these appear to represent species of other genera. Recent collections from Madagascar also appear to represent species of *Anisotes* (e.g., *Letsara et al. 874* at CAS, MO, and TAN), but have insufficient material to characterize fully and thus determine their taxonomic status.

Herein we describe four new species from northern and west-central Madagascar that conform to *Anisotes* based on the diagnostic characteristics noted above. Each of these species exhibits a feature that has not been documented previously in the genus: *A. hygroscopicus* T. F. Daniel, Letsara & Martín-Bravo and *A. venosus* T. F. Daniel, Letsara & Martín-Bravo have hygroscopic trichomes on the seeds, *A. subcoriaceus* T. F. Daniel, Letsara & Martín-Bravo has 2-colporate pollen lacking insulae, and *A. perplexus* T. F. Daniel, Letsara & Martín-Bravo has 2-pororate pollen. Each of these character states, unique and presumably apomorphic in *Anisotes*, is discussed relative to their occurrence elsewhere among related taxa of Justicieae. Palynological diversity and infrageneric affinities of these species are discussed relative to the classification of Baden (1981a).

Because each of the new species currently is known from few localities in a relatively small region of Madagascar, available information useful toward assessing the conservation status of each, based on IUCN Red List categories, criteria, and guidelines (IUCN, 2001, 2011), is summarized. ArcMap v. 10.0 (ESRI, 2010) was used to plot the studied populations and to estimate the extent of occurrence (EOO) and area of occupancy (AOO; grid size 4 km^2) of each species. Information necessary for a complete conservation assessment was insufficient to evaluate some of the criteria and subcriteria required by the IUCN to qualify species under the different categories of threat. Although all four species must be classified as "Data Deficient" at the present time, it is likely that some of them will eventually deserve protection under the IUCN guidelines.

Key to Species of *Anisotes* in Madagascar

1a. Leaves 5–45 mm, coriaceous to subsucculent; bracts all fertile, triangular to broadly triangular, 1–2 mm × 0.8–2.2 mm; bracteoles absent; calyx 1.3–3.5 mm; corolla externally glabrous or nearly so (occasionally with a few eglandular trichomes proximally), lobes of lower lip 8–14 mm; plants of southwestern and southern Madagascar (Toliara).

2a. Leaf blades broadly ovate to broadly elliptic to elliptic to ovate-elliptic, 14–45 × 10–38 mm, 1.1–2.7 times longer than wide, rounded (to emarginate) at apex; calyx 2–3.5 mm, margin of lobes ± densely ciliate; corolla with the internal surface conspicuously lighter in color than the external surface, the corolla tube:overall corolla length = 0.23–0.38, corolla tube 9–15 mm, upper lip 20–35 mm and distally whitish to pinkish along the margin, lower lip spirally coiled, 18–28 mm, lobes 12–14 mm; stamens 26–33 mm; capsule pubescent with flexuose to antrorse eglandular trichomes 0.05–0.1 mm long; growing on sandy flats and dunes . . . . . *A. madagascariensis*

2b. Leaf blades broadly obovate to subcircular to obcordate to obdeltate to oblate, 5–14 × 4.5–14.3 mm wide, 0.7–1.3 times as long as or longer than wide, emarginate to truncate at apex; calyx 1.3–2.7 mm, margin of lobes eciliate to sparsely ciliate; corolla with the internal surface not conspicuously lighter in color than the external surface, the corolla tube:overall corolla length = 0.46–0.56, corolla tube 14–20 mm, upper lip (11–)14–18 mm, lacking a pale margin distally, lower lip recurved to reflexed (not spirally coiled), 11–19 mm, lobes 8–12 mm; stamens 15–18.5 mm; capsule ± scurfy but lacking noticeable eglandular trichomes; growing on rocky limestone flats . . . . . *A. divaricatus*

1b. Leaves 27–203 mm, membranous to subcoriaceous; proximal pair or pairs of bracts usually sterile and smaller than fertile pairs, fertile bracts ovate to elliptic to oblate to subcircular to obovate, 4.5–17 × 2.3–12 mm; bracteoles present; calyx 6.7–11 mm; corolla externally pubescent ± throughout, often including glandular trichomes, lobes of lower lip 0.5–4 mm long; plants of northern and west-central Madagascar (Antsiranana, Mahajanga).

3a. Young stems pubescent with antrorsely appressed eglandular trichomes; fertile portion of spike 45–90 mm, rachis usually at least partially visible; abaxial surface of bracts with veins (except midvein) not or only barely evident; bracteoles ± elliptic to obovate-elliptic; corolla externally pubescent with eglandular trichomes only; thecae lacking basal appendages; pollen 2-pororate; plants occurring between 1100 and 2000 m in humid forest . . . . . *A. perplexus*

3b. Young stems glabrous or pubescent with retrorse eglandular trichomes; fertile portion of spike 10–30 mm, rachis not visible; abaxial surface of bracts with several orders of venation conspicuous; bracteoles linear to lanceolate to oblanceolate; corolla externally pubescent with glandular and eglandular trichomes; one or both thecae with basal appendages; pollen 2- or 3-colporate; plants occurring between 100 and 600 m in dry forest.

4a. Young stems pubescent with retrorse trichomes; leaf blades broadly ovate to cordate, truncate to cordate at base, 1.2–1.9 times longer than wide, surfaces pubescent; bracts 2.3–3 mm wide . . . . . *A. hygroscopicus*

4b. Young stems glabrous; leaf blades linear to elliptic, attenuate to cuneate to rounded to subauriculate at base, 2.8–10.3 times longer than wide, surfaces glabrous; bracts 4.5–12 mm wide.

5a. Leaves petiolate, petioles to 19 mm long, blades elliptic, 2.8–3.8 times longer than wide, attenuate at base; bracts green, sometimes tinged with maroon, subcoriaceous, apex round-

ed, entire or 2-fid or with a V-shaped split; corolla pale cream-yellow to yellow-green; pollen 2-colporate; plants of northern Madagascar (Antsiranana) .... *A. subcoriaceus*

5b. Leaves sessile to subsessile, petioles to 0.5 mm long, blades linear to linear-elliptic, 6.3–10.3 times longer than wide, rounded to cuneate to subauriculate at base; bracts light colored, papery, apex acute- to acuminate-apiculate (to caudate); corolla pink (to whitish); pollen 3-colporate; plants of west-central Madagascar (Mahajanga) .... *A. venosus*

1. Anisotes hygroscopicus T. F. Daniel, Letsara & Martín-Bravo, sp. nov. TYPE: Madagascar. Antsiranana: E sector of Ankarana Nat. Park, 0.4 km (air) NW of village of Mahamasina (at entryway to park along RN-6), 12°58.034′S, 49°08.112′E, 110 m, 16 July 2011 (fl., fr.), *T. Daniel, R. Letsara, H. Ranarivelo & J. Razanatsoa 11842* (holotype, CAS; isotypes, BR, G, K, MO, NY, P, RSA, TAN, US). Figures 1E–H, 2B–D.

Diagnosis. *Anisotes hygroscopicus* T. F. Daniel, Letsara & Martín-Bravo differs from all other species of the genus by the combination of leaf blades membranous, broadly ovate to cordate, 52–135 × 32–102 mm, 1.2–1.9 times longer than wide; bracts subcoriaceous, 5–6 × 2.3–3 mm; corollas greenish yellow, 30–40 mm, externally pubescent with both glandular and eglandular trichomes; pollen 3-colporate, 6-pseudocolpate; capsules 9–10 mm, glabrous; seeds pubescent with hygroscopic trichomes.

Erect to spreading branched shrubs to 1.5 m tall; older stems dark brown-purple; younger stems often ± zigzag, subterete to subquadrate, pubescent with retrorse eglandular trichomes 0.2–0.5 mm long, trichomes ± evenly disposed, sometimes becoming concentrated in 2 lines on more mature internodes and sometimes restricted to 2 lines on older stems. Leaves petiolate, petioles to 95 mm long, blades membranous, broadly ovate to cordate, 52–135 × 32–102 mm, 1.2–1.9 times longer than wide, truncate to cordate at base, acuminate at apex, surfaces pubescent (especially along major veins) with straight to flexuose eglandular trichomes, venation prominent, secondary veins 5 to 6 per side. Spikes axillary, mostly opposite at leaf nodes, 1 to 3 per axil (sometimes with a vegetative branch in axil as well), densely bracteate, pedunculate, peduncles 5–12 mm, evenly and ± densely pubescent with flexuose to retrorse eglandular trichomes to 0.5 mm long, fertile portion of spike subcylindric, 11–20 mm (excluding corollas), rachis not visible, puberulent with glandular and subglandular trichomes <0.05 mm long (glandular puberulent) and pubescent with an overstory of straight to flexuose eglandular trichomes to 0.3 mm long; bracts green, sometimes tinged with purple (especially distally), subcoriaceous, imbricate, ± 4-ranked (2 adjacent rows fertile, thus spikes ± secund), elliptic to obovate, 5–6 × 2.3–3 mm, rounded to acute at apex, abaxial surface glandular puberulent and sparsely pubescent with overstory of straight to flexuose eglandular trichomes 0.2–0.5 mm long, conspicuously veined with 5 to 7 veins subparallel to midvein, margin densely ciliate with straight to flexuose eglandular trichomes to 0.8 mm long; proximal pair (or pairs) of bracts usually sterile and sometimes smaller than distal bracts; bracteoles linear to oblanceolate, 3.7–5.5 × 1–1.5 mm, abaxial surface pubescent like bracts, prominently 3- to 5-veined with veins subparallel, margin ciliate like bracts. Calyx 6.7–8.5 mm, tube approximately equal to lobes in length (0.8–1 times as long as lobes), lobes lance-ovate, 3–4.5 × 1–2 mm, abaxially pubescent like bracts, margin hyaline (whitish) and ciliate; corolla greenish yellow, 30–40 mm, externally glandular puberulent and with an overstory of erect to retrorse eglandular trichomes to 0.1 mm long, tube proximally cylindric, ± expanded distally, 7–12 mm, 0.19–0.3 times as long as corolla, 2–2.5 mm diam. near midpoint, upper lip 22–32 mm, internally rugulate, apically entire, lower lip recoiled, 20–24 mm, lobes 2.3–4 × 0.8–1.5 mm; stamens 24–34 mm, inserted near apex of corolla tube, exserted from tube but not or only slightly (by up to 5 mm) exceeding upper lip, filaments whitish, glabrous, thecae greenish, unequally inserted (overlapping by 1.2–1.5 mm), glabrous, equal to unequal in size, distal theca 2.5–3.2 mm, sometimes longer than proximal theca, lacking basal appendage or with an inconspicuous appendage to 0.1 mm, proximal theca 2.3–3.1 mm, including a prominent basal appendage 0.4–0.7 mm; pollen 3-colporate, 6-pseudocolpate; style 33–39 mm, glabrous (at least distal half), stigma inconspicuous, lobes (if present) not evident. Capsule 9–10 mm, glabrous, stipe 3.5–4 mm, head 5–6 mm; seeds 4 per capsule, discoid, 1.3–2 × 1.2–1.8 mm, densely pubescent, trichomes eglandular, hygroscopic (appressed and uncinate when dry, erect and straight when moistened), 0.1–0.2 mm.

Distribution and habitat. *Anisotes hygroscopicus* is endemic to northern Madagascar (Antsiranana; Fig. 3). Plants occur in subdeciduous (dry to somewhat mesic) forests (western dry forest, fide Moat & Smith, 2007) on limestone at elevations between 110 and 275 m.

IUCN Red List category. *Anisotes hygroscopicus* is known from three collections (subpopulations) with an EOO of ca. 178 km² and an AOO of 12 km². The

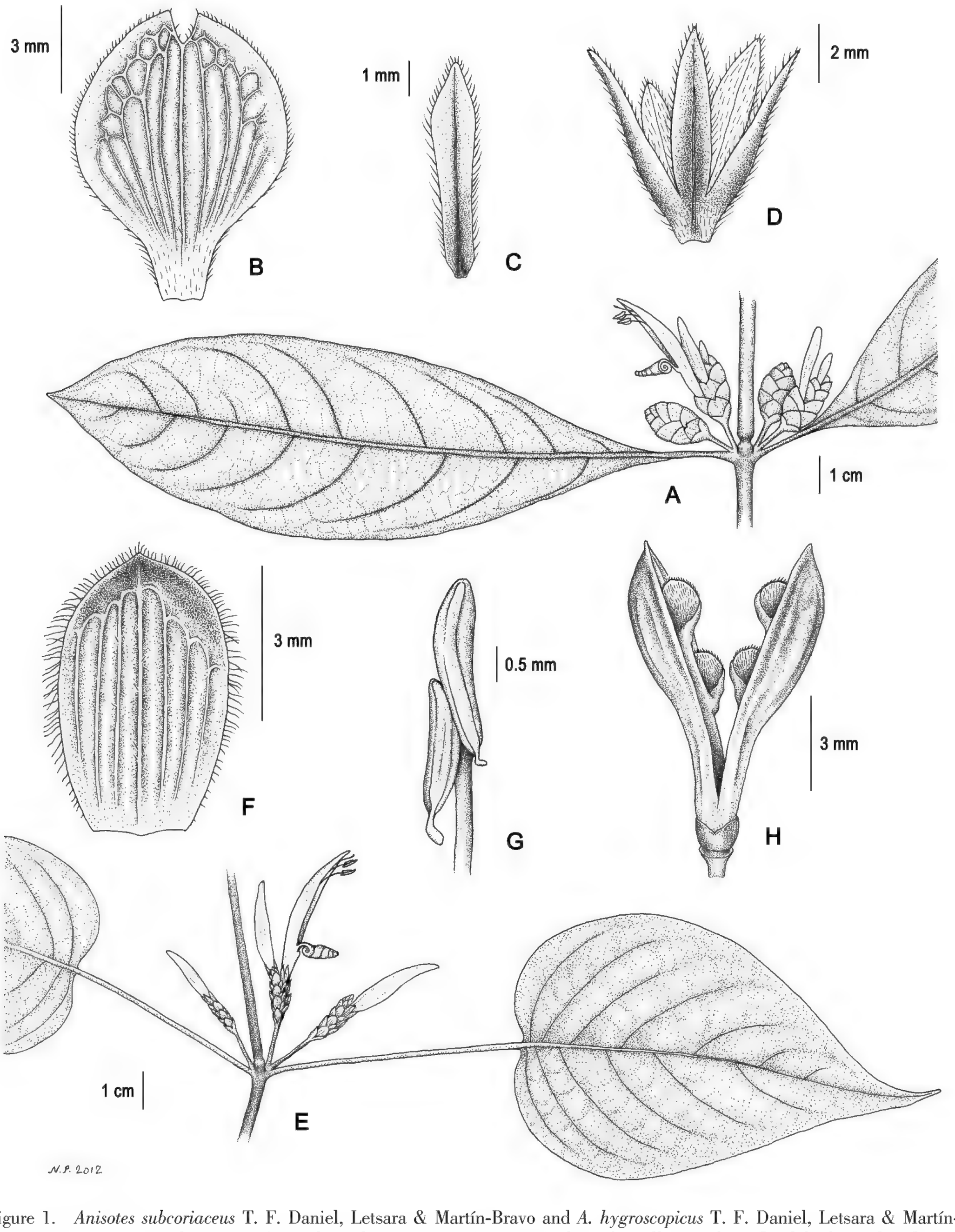

Figure 1. *Anisotes subcoriaceus* T. F. Daniel, Letsara & Martín-Bravo and *A. hygroscopicus* T. F. Daniel, Letsara & Martín-Bravo. A–D. *Anisotes subcoriaceus* (*Daniel et al. 11878*, CAS). —A. Node with axillary spikes, floral buds, and a flower. —B. Bract. —C. Bracteole. —D. Calyx. E–H. *Anisotes hygroscopicus* (*Daniel et al. 11842*, CAS). —E. Node with axillary spikes, floral buds, and a flower. —F. Bract. —G. Distal portion of stamen showing thecae with basal appendages. —H. Capsule with immature seeds.

number of locations (1–3) could not be determined because of the lack of information available about threats to the subpopulations (IUCN, 2001). The geographic range and the number of locations (maximum of 3) are well below the threshold to qualify the species as Endangered (EN) based on criteria B1 and B2, but this is currently not possible because information concerning subcriteria b and c is not available. These subcriteria refer to a verifiable continuing decline (subcriterion b) or extreme

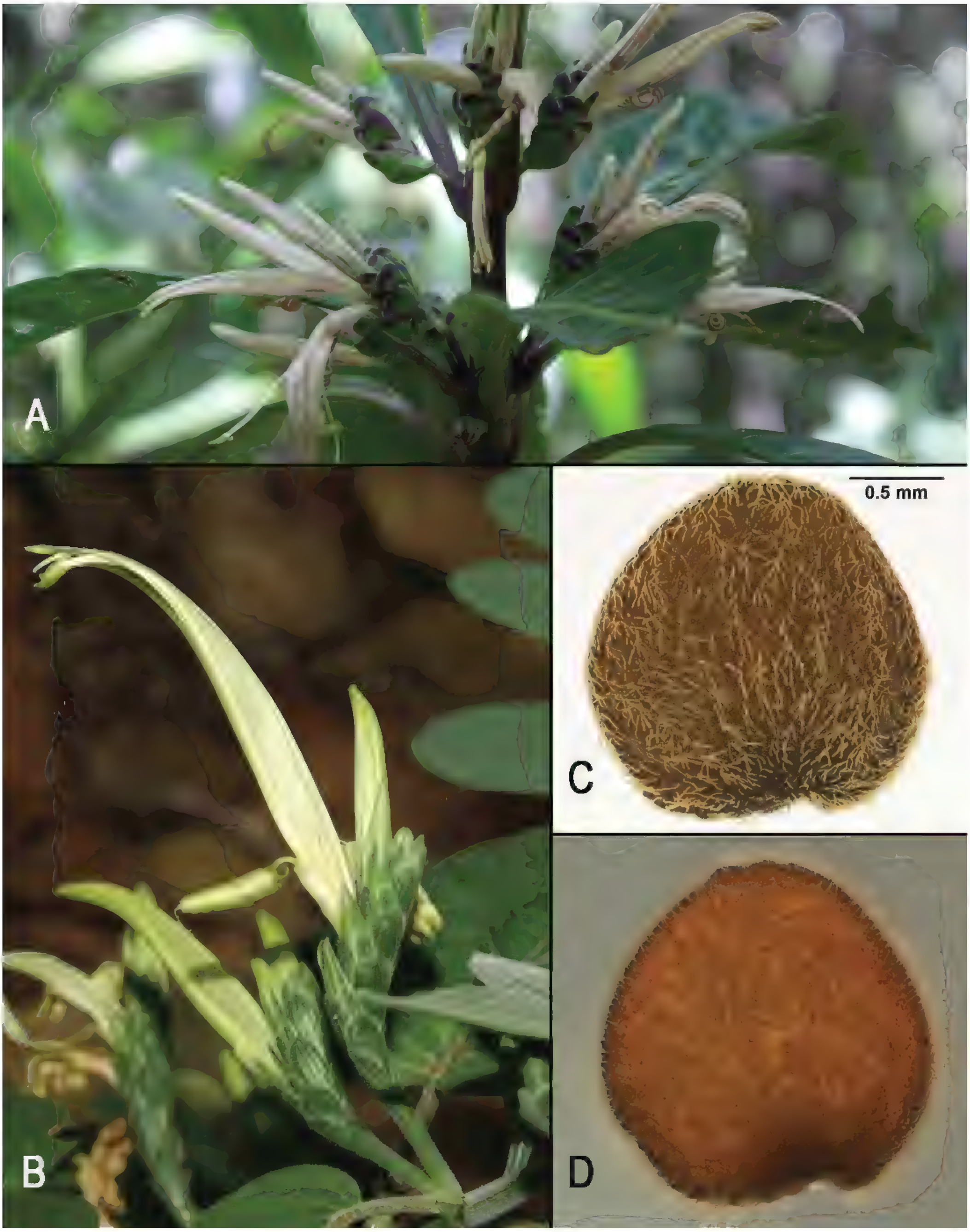

Figure 2. Photographs of reproductive structures of *Anisotes subcoriaceus* T. F. Daniel, Letsara & Martín-Bravo and *A. hygroscopicus* T. F. Daniel, Letsara & Martín-Bravo. —A. *Anisotes subcoriaceus* (*Daniel et al. 11878*, CAS), nodes showing spikes with flowers. —B. *Anisotes hygroscopicus* (*Daniel et al. 11842*, CAS), spikes with flowers. —C. *Anisotes hygroscopicus* (*Daniel et al. 10440*), dry seed with appressed trichomes. —D. *Anisotes hygroscopicus* (*Daniel et al. 10440*), same seed at same scale in water with erect trichomes.

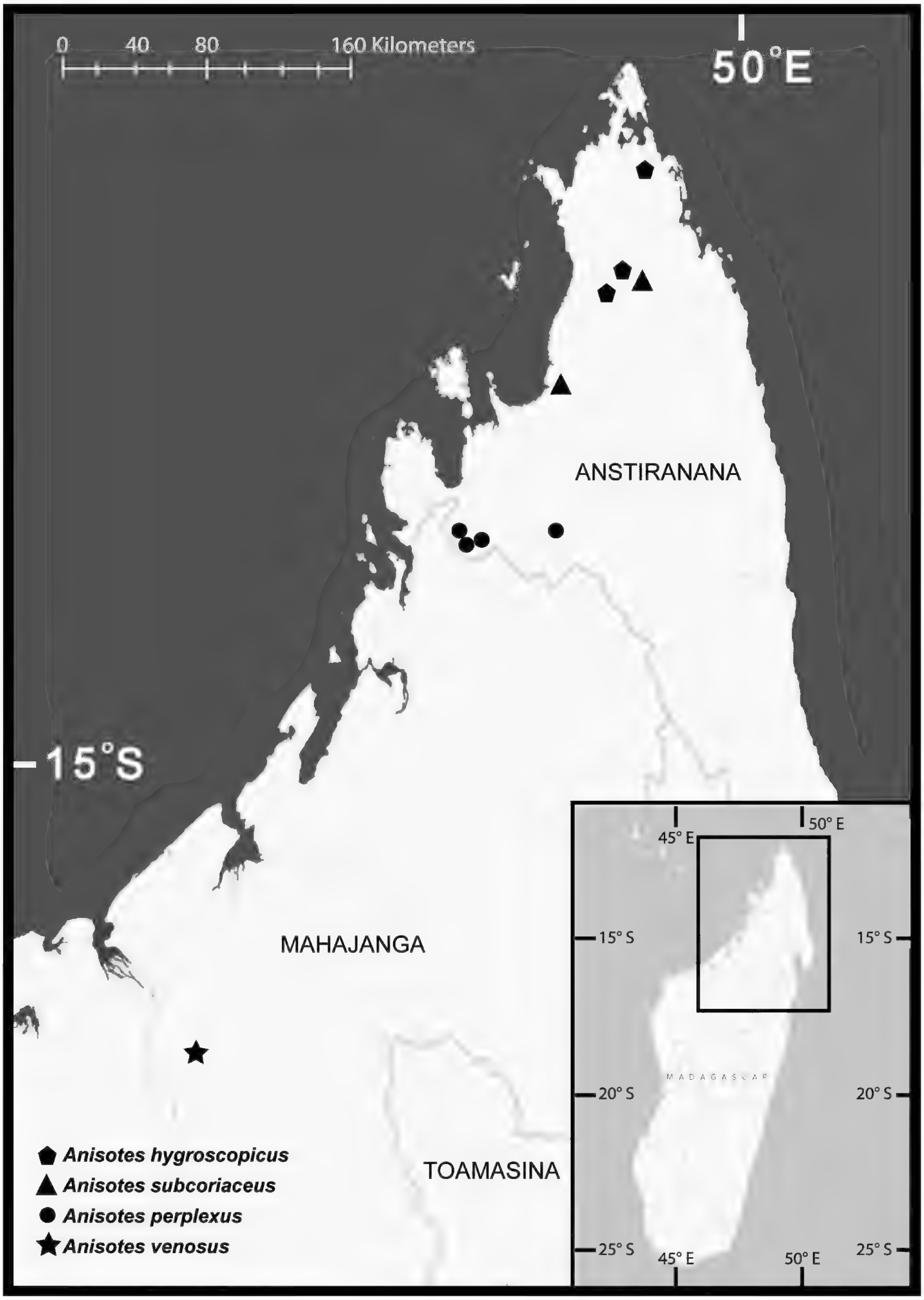

Figure 3. Map of northern and west-central Madagascar showing geographical distributions of the four species of *Anisotes* described here.

fluctuation (subcriterion c) in any of the EOO; AOO; area, extent, and/or quality of the habitat; number of locations; and number of mature individuals (IUCN, 2001, 2011). In addition, the species might qualify as Vulnerable (VU) based on criterion D2, because the AOO and the number of locations are smaller than 20 km^2 and fewer than five, respectively (i.e., guideline thresholds; IUCN, 2001). However, because the

species can be locally frequent (ca. 100 plants seen in the holotype subpopulation), plants can occur in disturbed habitats, and two of the three known subpopulations are well established on protected land (Ankarana Special Reserve), no clear plausible future threat is currently apparent as required by criterion D2. Given the lack of a knowledge of threats to *A. hygroscopicus*, it must be considered Data Deficient (DD) at this time.

Phenology. *Anisotes hygroscopicus* was collected in flower in June and July; fruiting is known during July and October.

Etymology. The epithet refers to the hygroscopic trichomes of the seeds, a feature previously unknown in the genus.

Discussion. Although seeds are not known for all species of *Anisotes*, none have been reported to bear hygroscopic trichomes. Seeds of species now treated in *Anisotes* are described as smooth to rugose or reticulate-tuberculate by Vollesen (2010) and as variable (including ridged, rugose, verrucate, tuberculate, reticulate-areolate, glabrate, and glandular) by Baden (1981a, 1981b). The hygroscopic trichomes of seeds of *A. hygroscopicus* (Fig. 2C, D) and *A. venosus* (see below) are apparently unique in the genus. Hygroscopic trichomes are common in some lineages of Acanthaceae (e.g., Ruellieae: *Brillantaisia* P. Beauv., *Dyschoriste* Nees, *Hygrophila* R. Br., *Louteridium* S. Watson, *Ruellia* L.; Whitfieldieae: *Lankesteria* Lindl.), but they are rare among Justicieae (e.g., *Justicia tenella* (Nees) T. Anderson; Daniel & Figueiredo, 2009). These occurrences likely reflect independent origins of this characteristic within the family.

Pollen of *Anisotes hygroscopicus* (*Daniel et al. 11842* and *Phillipson 1978*; Fig. 4A, B), with three colpori, each flanked on both sides by a pseudocolpus, resembles that of *A. divaricatus* and *A. madagascariensis* from Madagascar (Daniel et al., 2007) and *A. formosissimus* (Klotzsch) Milne-Redh. from Africa, all of which conform to Baden's (1981a) *Anisotes* sect. *Spiciflori* Baden. *Anisotes hygroscopicus* differs from species in section *Spiciflori* by its conspicuous and somewhat camptodrome-reticulate veined bracts (vs. veins not evident in *A. madagascariensis* and not conspicuously camptodromous in *A. formosissimus*) and somewhat smaller corolla tube: overall corolla length (0.19–0.3 vs. 0.23–0.38). Baden (1981a) also attributed pollen like that of *A. hygroscopicus* and species of section *Spiciflori* to the African species *A. tanensis* Baden in his key to species based on pollen characters, in his description of pollen for this species, and in his figure 2E; however, he included *A. tanensis* in his section *Anisotes*, for which he described the pollen as having three (rarely two) apertures flanked by two rows of insulae. It appears that he emphasized morphological characters other than pollen in his classification of *A. tanensis*, and that *A. hygroscopicus* cannot be classified with certainty using Baden's (1981a) infrageneric taxonomy.

Paratypes. MADAGASCAR. **Antsiranana:** Ankarana Special Reserve, N sector, Sentier Botanique on E side of Ambilobe-Antsiranana Hwy. (RN 6), ca. 47 km N of Ambilobe, 12°51′42″S, 49°10′30″E, 15 Oct. 2003 (fr.), *T. Daniel, L. McDade & H. Ranarivelo 10440* (BR, CAS, K, MO, TAN, US); 19 km S of Antsiranana on rd. to Ambilobe [ca. 12°25′S, 49°20′E], 29 June 1987 (fl.), *P. Phillipson 1978* (CAS, MO).

2. Anisotes perplexus T. F. Daniel, R. Letsara & Martín-Bravo, sp. nov. TYPE: Madagascar. Antsiranana: E of Ankaramy, Réserve Spéciale Manongarivo, Antsatrotro, SE of summit, river valley betw. Antsatrotro & massif, montane moss forest with bamboo, 14°05′S, 48°23′E, 1470–1570 m, 14–15 Apr. 1992 (fl.), *S. Malcomber, J. Hutcheon, A. Razafimanantsoa & M. Zjhra 1481* (holotype, MO; isotypes, BM, K). Figure 5A–E.

Diagnosis. *Anisotes perplexus* T. F. Daniel, R. Letsara & Martín-Bravo differs from all other species of the genus by the combination of leaf blades membranous, lanceolate to narrowly elliptic, 49–137 × 6.5–29 mm, 4.2–7.8 times longer than wide; bracts (5–)7–11 × 3–6 mm, abruptly acuminate-caudate acropetally; corollas yellow with lower lip darker yellow, 35–45 mm, externally pubescent with eglandular trichomes; pollen 2-pororate; capsules 8.5–13 mm, glabrous; and seeds coarsely rugulate.

Clambering shrubs to 3.4 m tall; older stems brownish or brownish maroon; younger stems ± straight, subquadrate, pubescent with antrorsely appressed eglandular trichomes 0.1–0.3 mm long, trichomes ± evenly disposed or concentrated in 2 lines. Leaves petiolate, petioles to 15 mm long, blades membranous, lanceolate to narrowly elliptic, 49–137 × 6.5–29 mm, 4.2–7.8 times longer than wide, cuneate to attenuate at base, acuminate at apex, surfaces pubescent (especially along major veins adaxially and midvein abaxially) with antrorse to antrorsely appressed eglandular trichomes or nearly glabrous abaxially, venation evident but not prominent, secondary veins 5 to 11 per side. Spikes axillary, opposite or alternate at leaf nodes, 1 per axil, loosely to ± densely bracteate, pedunculate, peduncles 2–7 mm, evenly pubescent with antrorsely appressed eglandular trichomes 0.1–0.3 mm long, fertile portion of spike (excluding corollas) 45–90 mm

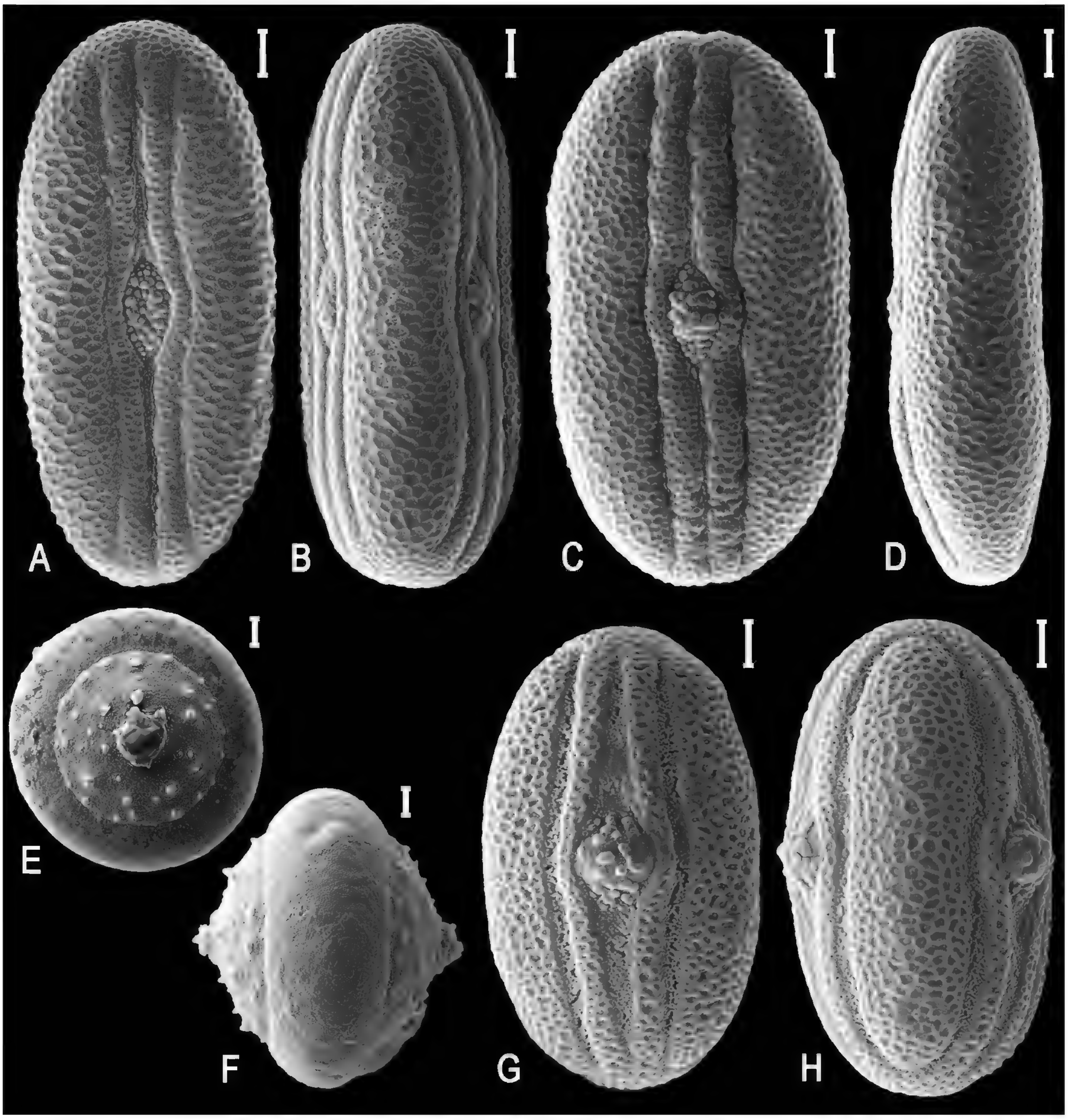

Figure 4. Photomicrographs of pollen. A–B. *Anisotes hygroscopicus* T. F. Daniel, Letsara & Martín-Bravo (*Daniel et al. 11842*, CAS). —A. Apertural view. —B. Interapertural view. C–D. *Anisotes subcoriaceus* T. F. Daniel, Letsara & Martín-Bravo (*Daniel et al. 11878*, CAS). —C. Apertural view. —D. Interapertural view. E–F. *Anisotes perplexus* T. F. Daniel, Letsara & Martín-Bravo. —E. Apertural view (*Gautier et al. 2458*). —F. Interapertural view (*Malcomber et al. 1481*, MO). G–H. *Anisotes venosus* T. F. Daniel, Letsara & Martín-Bravo (*Phillipson 1904*, CAS). —G. Apertural view. —H. Interapertural view. All scales = 5 μm.

long, rachis usually at least partially visible, evenly pubescent with antrorse eglandular trichomes 0.1–0.5 mm long; bracts color unknown (presumably greenish), ± membranous, remote to imbricate, 4-ranked, those at a node both fertile or usually only 1 fertile, ± ovate to elliptic to obovate, (5–)7–11 × 3–6 mm, abruptly acuminate-caudate acropetally, abaxial surface pubescent with antrorse to antrorsely appressed eglandular trichomes 0.05–0.5 mm long, veins (except for midvein) not or but barely evident, margin ± densely ciliate with erect to flexuose eglandular trichomes to 1 mm long; proximal pair(s) of bracts usually sterile; bracteoles ± elliptic to obovate-elliptic, 6–10 × (2.5–)3–4.5 mm, apically abruptly acuminate, abaxial surface pubescent like bracts, only midvein evident, margin ciliate like bracts; calyx 8–11 mm, tube 1.5–4 mm, 0.39–1 times as long as lobes, lobes lance-linear, 4–7 × 0.6–1.5 mm, abaxial surface and margin pubescent like bracts, margin not hyaline, ciliate; corolla lemon yellow with lower lip darker yellow, 35–45 mm long, externally pubescent with flexuose to retrorse

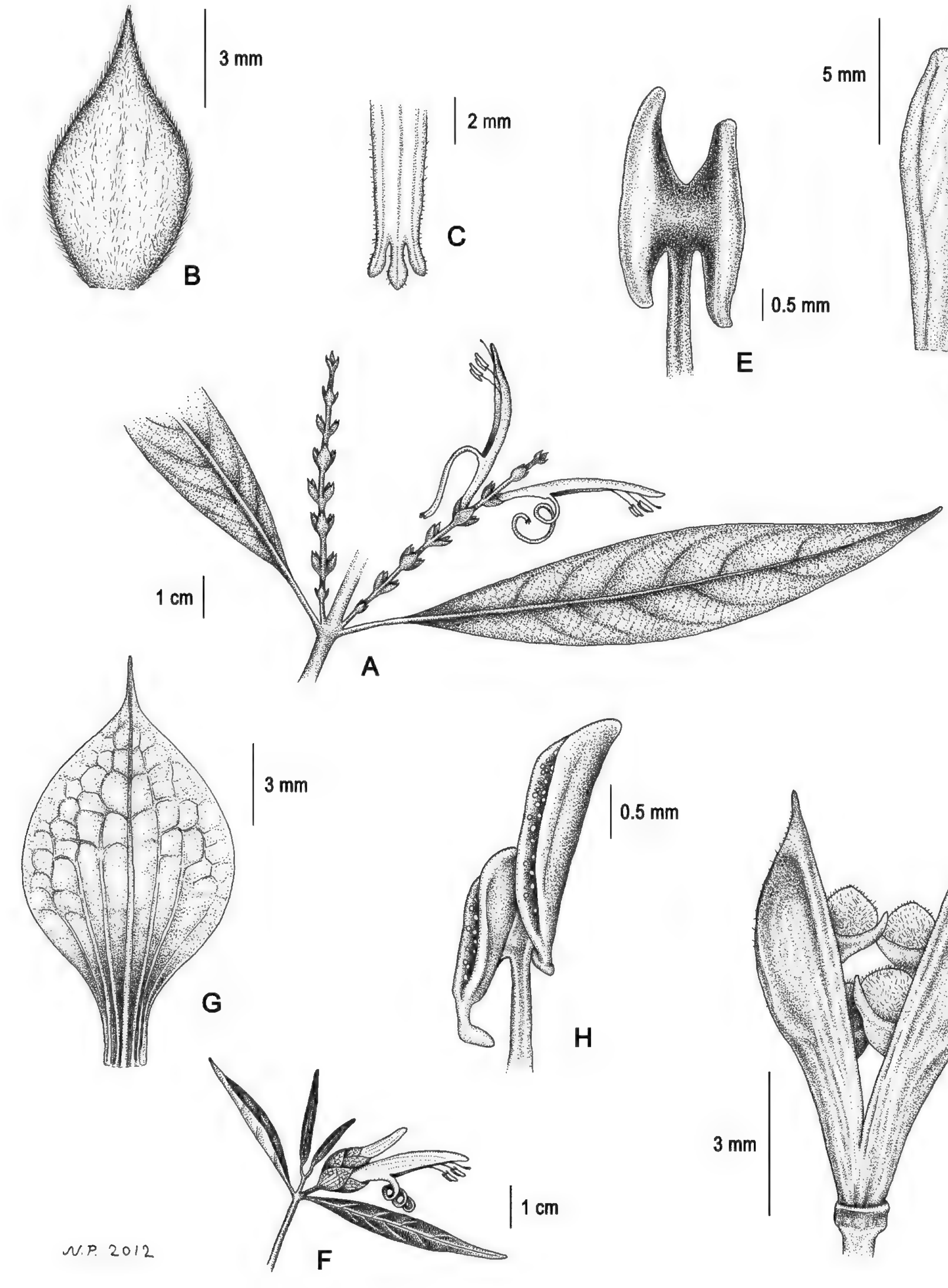

Figure 5. *Anisotes perplexus* T. F. Daniel, Letsara & Martín-Bravo and *A. venosus* T. F. Daniel, Letsara & Martín-Bravo. A–E. *Anisotes perplexus*. —A. Node with leaves and axillary spikes with flowers. —B. Bract. —C. Distal portion of lower lip of corolla showing lobes. —D. Distal portion of upper lip of corolla showing rugula partially enclosing style. —E. Distal portion of stamen with anther. F–I. *Anisotes venosus*. —F. Distal nodes with leaves and spike with floral bud and flower. —G. Bract. —H. Distal portion of stamen with anther. —I. Capsule with immature seeds. Drawn from: A, *Perrier de la Bâthie 16151* (P); B–E, *Gautier et al. 2458*; F, H, *Phillipson 1904* (CAS); G, I, *Schatz & Lowry 1428* (CAS).

eglandular trichomes 0.1–0.4 mm long tube 11–15 mm, cylindric proximally and expanded distally, 0.31–0.37 times as long as corolla, 1–1.1 mm diam. near midpoint, upper lip 21–31 mm, internally rugulate, apically 2-fid, lower lip recoiled, 23–29 mm, lobes linear 0.5–2 × 0.3–0.5 mm; stamens 25–30 mm, inserted near apex of corolla tube, exserted from tube but not extending beyond upper lip,

filaments proximally pubescent with eglandular trichomes, distally glabrous, thecae parallel, 2.9–4 mm long, those of a pair subequal in size (distal theca slightly longer), (equally to) subequally to unequally inserted (overlapping by 2.2–3.2 mm), glabrous, lacking basal appendages; pollen 2-pororate, pores granulate and subechinate to verrucate, or subechinate to verrucate, interapertural exine perforate-microreticulate (appearing subpsilate), sometimes with scattered granulae or verrucae; style 37–44 mm, stigma inconspicuous, lobes (if present) not evident. Capsule 8.5–13 mm, glabrous, stipe 2–5 mm, head 6.5–8 mm; seeds 4 per capsule, discoid, 3.3 × 2.5 mm, surfaces coarsely rugulate (i.e., with elongate-branched ridges irregularly distributed tangentially over surface).

Distribution and habitat. *Anisotes perplexus* is endemic to the highlands of west-central Antsiranana in northern Madagascar (Fig. 3) where plants occur in mesic montane forests (humid forest, fide Moat and Smith, 2007) at elevations between 1100 and 2000 m.

IUCN Red List category. Among the four species of *Anisotes* described here, *A. perplexus*, which is known from four subpopulations, is the one with the largest EOO (ca. 192 km^2) and AOO (16 km^2). However, like *A. hygroscopicus* and *A. subcoriaceus*, it might qualify as either Endangered (EN; depending on unknown data for subcriteria b or c of criterion B) or Vulnerable (VU) under criterion D2 (if a plausible future threat were known). Because all known occurrences of *A. perplexus* are on protected lands (Manongarivo and Tsaratanana reserves), some threats to the persistence of the species are undoubtedly reduced. Given the lack of knowledge of threats to *A. perplexus*, it must be considered Data Deficient (DD) at this time.

Phenology. *Anisotes perplexus* was collected in flower between March and June and in October; a fruiting collection is known from October.

Etymology. The epithet derives from the perplexing pollen of this species, which among Acanthaceae is otherwise known only in tribes Justicieae: Isoglossinae and Whitfieldieae.

Discussion. Two-pororate pollen, like that of *Anisotes perplexus* (Fig. 4E, F), has not been previously reported among species of *Anisotes*. Indeed, among Acanthaceae this type of pollen is known only among Justicieae: Isoglossinae (Kiel et al., 2006) and Whitfieldieae (Manktelow et al., 2001). The occurrence of this pollen type in the collections sampled (*Gautier 2458*, *Humbert & Capuron 25721*, and *Malcomber et al. 1481*) is unexpected and perplexing. Either pollen in *Anisotes* (and Justiciinae) is considerably more labile than previously known, or macromorphological characteristics of a species pertaining to another major lineage of Acanthaceae have converged with those of *Anisotes*. Using molecular sequence data we are currently testing which case of convergent evolution is relevant. Based on macromorphological characteristics that delimit sections of *Anisotes* (Baden, 1981a: 631), *A. perplexus* appears to have some characteristics of *Anisotes* sect. *Bracteati* Baden (e.g., "corolla/tube-ratio small") and others of section *Macrophylli* Baden (e.g., bracts not reticulate-nerved). Thus, sectional placement of *A. perplexus* remains unresolved.

Paratypes. MADAGASCAR. **Antsiranana:** Bekolosy, vallon en amont de la chute de la rivière Bekolosy, coord. Laborde 600983/1336098, forêt d'altitude, [14°02′S, 048°18′E], 25 June 1994 (fl.), *L. Gautier, C. Chatelain & P. Derleth 2458* (G, K, MO); Distr. d'Ambilobe, Massif de Marivorahona au SW de Manambato (Haute Mahavavy du Nord), sylve à lichens sur gneiss, 18–26 Mar. 1951 (fl.), *H. Humbert & R. Capuron 25721* (K, P); Manongarivo Massif, above village of Ambodisakoana, E of Ankaramy, forested slopes, 14°05′S, 48°20′E, 18 Oct. 1994 (fl., fr.), *G. McPherson & H. van der Werff 16400* (K, MO); central Madagascar, Mt. Tsaratanana [ca. 14°00′07″S, 48°50′08″E], Apr. 1924 (fl.), *H. Perrier de la Bâthie 16151* (P).

3. Anisotes subcoriaceus T. F. Daniel, Letsara & Martín-Bravo, sp. nov. TYPE: Madagascar. Antsiranana: slopes in Andrafiamena transitional forest, ca. 2.3 km (air) SE of village of Anjahakely, 12°55.187′S, 49°19.859′E, 500 m, 20 July 2011 (fl.), *T. Daniel, R. Letsara, H. Ranarivelo & J. Razanatsoa 11878* (holotype, CAS; isotypes, BR, G, K, MO, NY, P, RSA, TAN, US). Figures 1A–D, 2A.

Diagnosis. *Anisotes subcoriaceus* T. F. Daniel, Letsara & Martín-Bravo differs from all other species of the genus by the combination of leaf blades subcoriaceous, elliptic, 95–203 × 25–69 mm, 2.8–3.8 times longer than wide; bracts subcoriaceous, 4.5–10.5 × 4.5–8 mm; corollas pale cream-yellow to yellow-green and with maroon markings, 31–41 mm, externally pubescent with both glandular and eglandular trichomes; and pollen 2-colporate and 4-pseudocolpate.

Erect to clambering monocaulous to branched shrubs to 3 m tall; older stems brown-black or dark green; younger stems straight, subquadrate (shallowly sulcate on corners), glabrous. Leaves petiolate, petioles to 19 mm, blades subcoriaceous, elliptic, 95–203 × 25–69 mm, 2.8–3.8 times longer than

wide, attenuate at base, acute to acuminate at apex, surfaces glabrous, venation evident to ± prominent, secondary veins 5 to 7 per side. Spikes axillary, mostly opposite at leaf nodes, (1 or)2 to 4 per axil (sometimes with a vegetative branch in axil as well), densely bracteate, pedunculate, peduncles 4–17 mm, glabrous or sparsely pubescent with antrorsely appressed eglandular trichomes to 0.1 mm long, fertile portion of spike subcylindric, 10–26 mm (excluding corollas), rachis not visible, pubescent with antrorsely appressed eglandular trichomes 0.5–1 mm long; bracts green or sometimes tinged with maroon, subcoriaceous, imbricate, 4-ranked (2 adjacent rows fertile, thus spikes ± secund), oblate to subcircular to broadly elliptic to obovate, 4.5–10.5 × 4.5–8 mm, rounded at apex and either entire, 2-fid, or with a V-shaped split in center, abaxial surface inconspicuously puberulent with erect subglandular trichomes to 0.05 mm long (glandular puberulent) or appearing glabrous (and often pubescent near base with trichomes like those of rachis as well), ± conspicuously veined, major veins 7 to 9, subparallel to midvein, margin densely ciliate with erect to flexuose eglandular trichomes 0.1–0.6(–1) mm long; proximal pair (or pairs) of bracts sterile and smaller than fertile pairs, 2.5–6 × 2.5–6 mm; bracteoles linear to linear-oblanceolate to lance-linear, 4.5–6.5 × 0.8–1.2 mm, abaxial surface subglandular puberulent and also with appressed eglandular trichomes to 0.8 mm long proximally, only midvein evident, margin ciliate like bracts. Calyx 7.5–8 mm, tube 1–1.5 mm, 0.14–0.23 times as long as lobes, lobes lanceolate, 6.5–7 × 1–1.4 mm, abaxial surface and margin pubescent like bracteoles or with midvein pubescent with antrorse eglandular trichomes its entire length, margin hyaline, ciliate; corolla pale cream-yellow to yellow-green, with maroon markings on lower lip and maroon tinged on internal surface of upper lip, 31–41 mm, externally pubescent with an overstory of retrorse (proximally) to antrorse (distally) eglandular trichomes 0.2–0.5 mm long and an understory of ± erect glandular trichomes to 0.1 mm long, tube subcylindric proximally and expanded distally, 13–16 mm, 0.36–0.43 times as long as corolla, 1.5–1.7 mm diam. near midpoint, upper lip 17–25 mm, internally rugulate, apically entire, lower lip recoiled, 15–21 mm, lobes 1.3–1.8 × 0.8–1.2 mm; stamens 17–23 mm, inserted near apex of corolla tube, filaments pubescent with eglandular trichomes proximally, glabrous distally, thecae parallel, 2–3.5 mm (distal theca longer), unequally inserted (overlapping by 1.2–1.5 mm), glabrous, both thecae with a conspicuous basal appendage 0.2–0.6 mm; pollen 2-colporate, 4-pseudocolpate, with regions (bands) of exine between colpi and pseudocolpi sometimes ± breaking up into insulae toward poles; style 27–30 mm, proximally sparsely pubescent, distally glabrous, stigma inconspicuous, lobes (if present) not evident. Capsule and seeds not seen.

Distribution and habitat. *Anisotes subcoriaceus* is endemic to northern Madagascar (Antsiranana; Fig. 3) where plants occur in subdeciduous dry (to somewhat mesic) forest (western dry forest, fide Moat & Smith, 2007) and windswept scrub on sandstone at elevations between 100 and 570 m.

IUCN Red List category. This species is known from three collections (two of them from the same 4 km² grid) that correspond to two subpopulations (IUCN, 2001). The EOO (ca. 30 km²), AOO (8 km²), and number of locations (maximum of 2) would place this species in the Endangered (EN) category under criteria B1 and B2, but lack of information for subcriteria b or c preclude designating this conservation category at the present time. According to criterion D2, *Anisotes subcoriaceus* might also be considered as Vulnerable (VU) based on the AOO and number of locations, if a plausible threat to the species could be identified. No such threat is currently known. One of the subpopulations occurs in a reserve (community-based protected land under auspices of the Malagasy NGO, FANAMBY) in the Andrafiamena transitional forest. Between 75 and 100 plants of various sizes and ages were observed in 2011 along a 1-km segment of trail in this forest. Given the lack of a knowledge of threats to *A. subcoriaceus*, it must be considered Data Deficient (DD) at this time.

Phenology. *Anisotes subcoriaceus* was collected in flower in June and July; fruiting collections are unknown.

Etymology. The epithet derives from the subcoriaceous texture of the leaves and bracts of this species.

Discussion. Pollen of *Anisotes subcoriaceus* (*Daniel et al. 11878* and *Phillipson 2010*; Fig. 4C, D), with two colpori and four pseudocolpi (i.e., no insulae in trema region), resembles pollen of several species of *Justicia* (Graham, 1988; Daniel, 1990, 1998), but was not noted among pollen types of *Anisotes* or *Metarungia* by Baden (1981a, 1981b). Based on other characters used by Baden (1981a) to delimit sections of *Anisotes* (e.g., inflorescence type, bract venation, and the ratio of the corolla tube length to the overall corolla length), *A. subcoriaceus* would

appear to conform to *Anisotes* sect. *Bracteati*. This section also has pollen with two apertures, but with the apertures flanked by insulae. Thus, sectional placement of *A. subcoriaceus* remains unresolved.

Paratypes. MADAGASCAR. **Antsiranana:** windswept ridge in Andrafiamena transitional forest, ca. 3.1 km (air) SE of village of Anjahakely, 12°55.608′S, 49°20.110′E, 20 July 2011 (fl.), *T. Daniel, R. Letsara, H. Ranarivelo & J. Razanatsoa 11879* (CAS, K, MO, P, TAN); Tandavan I Galoko (Chane du Galoka), SW of Ambilobe, NE end of ridge, 5 km along rd. from Beramanja, 13°23′S, 48°54′E, 1 July 1987 (fl.), *P. Phillipson 2010* (CAS, MO).

4. Anisotes venosus T. F. Daniel, R. Letsara & Martín-Bravo, sp. nov. TYPE: Madagascar. Mahajanga: Ampijoroa Forest Station, plateau W of station, 16°19′S, 46°49′E, 150 m, 20 June 1987 (fl.), *P. Phillipson 1904* (holotype, CAS; isotype, MO). Figure 5F–I.

Diagnosis. *Anisotes venosus* T. F. Daniel, R. Letsara & Martín-Bravo differs from all other species of the genus by the combination of leaf blades linear to linear-elliptic, 27–125 × 3–18 mm, 6.3–10.3 times longer than wide; bracts papery, 9–17 × 5–12 mm, abaxially conspicuously venose; corollas usually pink, 27–35 mm long, externally pubescent with eglandular and glandular trichomes; pollen 3-colporate, 6-pseudocolpate; capsules 8.5–9 mm long, puberulent with glandular and eglandular trichomes; and seeds pubescent with hygroscopic trichomes.

Shrubs to 1.5 m tall; older stems pinkish to reddish purple; younger stems not zigzag, quadrate-sulcate (to quadrate-alate), glabrous. Leaves sessile to subsessile, petioles, if present, to 0.5 mm, blades membranous to subcoriaceous, linear to linear-elliptic, 27–125 × 3–18 mm, 6.3–10.3 times longer than wide, rounded to cuneate to subauriculate at base, rounded to subacuminate at apex; surfaces glabrous, venation evident but not prominent (except for midvein), secondary veins 4 to 6 per side. Spikes axillary, alternate or opposite at leaf nodes, one per axil, densely bracteate, pedunculate, peduncles 4–12 mm, glabrous, fertile portion of spike (excluding corollas) 14–30 mm, rachis not visible, evenly pubescent with erect to antrorse eglandular trichomes to 0.2 mm long and erect glandular trichomes to 0.05 mm long; bracts light colored, papery, imbricate, 4-ranked (2 adjacent rows usually fertile, thus spikes ± secund), ovate to elliptic, 9–17 mm × 5–12 mm, acuminate- to acute-apiculate (to -caudate in proximal bracts) at apex, apiculum 0.5–1 mm, abaxial surface puberulent with glandular and eglandular trichomes < 0.05–0.2 mm long, veins green, conspicuous, major veins 5 to 7, subparallel to midvein, margin ciliate with eglandular (and glandular) trichomes to 0.4 mm long; proximal pair of bracts sterile; bracteoles lanceolate, 4.5–8 × 0.6–1.2 mm, apically aristate, abaxial surface and margin pubescent like bracts, veins 1 to 3, prominent and subparallel. Calyx 8–9 mm, tube 0.5–1 mm (0.06–0.2 times as long as lobes), lobes lanceolate, 5.5–8 mm, unequal in length (i.e., posterior lobe ca. 0.7 times as long as other lobes), 0.7–1.4 mm wide, abaxial surface pubescent with erect to flexuose glandular and eglandular trichomes < 0.05–0.2 mm long, margin hyaline and ciliate; corolla pink, darker so around edges of upper lip and on internal surface of lower lip (corolla whitish fide *Ramamonjisoa 2827*), 27–35 mm, externally pubescent with erect to flexuose eglandular and glandular trichomes 0.05–0.3 mm long, tube proximally cylindric and distally expanded, 12 mm, 0.39 times as long as corolla, 2.5 mm diam. near midpoint, upper lip 18–19 mm, apically entire, lower lip recoiled, 17 mm, lobes 1.5 mm × 0.9 mm; stamens 19–20 mm, inserted near apex of corolla tube, exserted from tube but not extending beyond upper lip of corolla, filaments glabrous, thecae parallel, 1.7–2.5 mm, unequal in length (distal theca conspicuously longer than proximal theca), unequally inserted (overlapping by 0.7–1.2 mm), glabrous, distal theca with an inconspicuous basal appendage 0.1 mm, proximal theca with a conspicuous basal appendage 0.3–0.5 mm; pollen 3-colporate, 6-pseudocolpate, the 2 pseudocolpi in each mesocolpium sometimes fused near poles to form pseudocolpal ellipses; style 29 mm, glabrous distally, pubescent with eglandular trichomes proximally, stigma inconspicuous, lobes (if present) not evident. Capsule 8.5–9 mm, puberulent with erect glandular and eglandular trichomes 0.05–0.1 mm long, stipe 2.5–3 mm, head 6 mm; seeds 4 per capsule, discoid, 1.5–1.7 × 1.4–1.5 mm, densely pubescent; trichomes eglandular, hygroscopic (flexuose and ± appressed when dry, erect and straight when moistened), 0.2 mm long.

Distribution and habitat. *Anisotes venosus* is endemic to west-central Madagascar (Mahajanga; Fig. 3) where plants occur in sandy, dry deciduous forests (western dry forest, fide Moat & Smith, 2007) at elevations near 150 m.

IUCN Red List category. The three known collections of *Anisotes venosus* are from the same area of the Massif de l'Ankarafantsika in Ankarafantsika National Park. Both frequency and number of individuals remain unknown. Based on the data at hand, this could be the most threatened of the four newly described species because the collection sites occur in the same grid cell and therefore correspond to only one subpopulation (IUCN, 2001) in an

extremely reduced AOO of 4 km². This would classify the species as Critically Endangered (CR) under criterion B2 if appropriate knowledge of subcriteria b or c were available. Alternatively, it could be classified as Vulnerable (VU) under criterion D2 if a plausible future threat to its survival could be identified. Given the lack of knowledge of threats to *A. venosus*, it must be considered Data Deficient (DD) at this time.

Phenology. *Anisotes venosus* was collected in flower during May and June; a fruiting collection is known from August.

Etymology. The epithet refers to the conspicuous green veins of the bracts.

Discussion. Benoist labeled *Ramamonjisoa 2827* with an unpublished name ("A. reticulatus"). Pollen of *Anisotes venosus* (*Phillipson 1904* and *Ramamonjisoa 2827*; Fig. 4G, H) resembles that of three Malagasy species (*A. hygroscopicus*, *A. divaricatus*, and *A. madagascariensis*) and two African species (*A. formosissimus* and *A. tanensis*; see above under *A. hygroscopicus*). The two pseudocolpi in each mesocolpium sometimes fuse near the poles, forming pseudocolpal ellipses (Fig. 4H), a common phenomenon in this type of pollen. Like *A. hygroscopicus*, the infrageneric position of *A. venosus* is not certain. It has pollen and inflorescence features (i.e., spikes) of section *Spiciflori* (Baden, 1981a: 631), but has somewhat camptodrome-reticulate veined bracts (vs. bracts not reticulate veined in *Anisotes* sect. *Spiciflori*) and a relatively small corolla tube length:corolla length ratio (vs. "corolla/tube-ratio large" in section *Spiciflori*). Like those of *A. hygroscopicus*, seeds of *A. venosus* are covered with hygroscopic trichomes, a feature not previously reported for species in this genus.

Paratypes. MADAGASCAR. **Mahajanga:** Distr. Ambato-Boeni, Canton Tsaramandroso, R.N. 7, forêt sablonneuse, 29 May 1951 (fl.), *N. Ramamonjisoa (Service Forestier #) 2827* (P); Western Domain Forestry Station at Ampijoroa, ca. 108 km SE of Mahajanga along Rte. Nat. 4, 16°19′S, 46°47′E, 11 Aug. 1987 (fr.), *G. Schatz & P. Lowry 1428* (CAS).

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Validation of the Name *Ulmus kunmingensis* (Ulmaceae)

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Abstract. *Ulmus kunmingensis* W. C. Cheng (Ulmaceae), originally described in 1963, was an invalidly published name, because two collections, one flowering and one fruiting, were designated as types. The name is validated here with the designation of the fruiting collection *W. C. Cheng 11002* (NF) as the holotype.

Key words: China, Ulmaceae, *Ulmus*.

Ulmus kunmingensis W. C. Cheng (Cheng et al., 1963) was described based on material from Kunming, Yunnan, China. Unfortunately, it is invalidly published under Articles 8.1, 40.1, and 40.2 of the Melbourne Code (McNeil et al., 2012) because two collections, both kept at NF, one flowering (*W. C. Cheng 11002*) and the other fruiting (*T. C. Chao 1516*), were cited concurrently as types in the protologue. In the original description, Cheng et al. (1963) compared the species with *U. glaucescens* Franch. However, *U. kunmingensis* is easily distinguished from the latter by its seed apex not reaching the notch, and these two species were placed by Fu (1980) in different series, *Ulmus* ser. *Glabrae* Moss. and *Ulmus* ser. *Nitentes* Moss., respectively. Fu et al. (1979) reduced the name to the rank of variety as *U. changii* W. C. Cheng var. *kunmingensis* (W. C. Cheng) W. C. Cheng & L. K. Fu, but no validation of the basionym was undertaken at that time. Since then, some authors have treated *U. kunmingensis* as an independent taxon at the rank of species (Fu, 1980; Fu et al., 1982; Liu, 1985; Bao, 1990; Ma & Zhou, 1997; Mao, 2005; Li, 2006), while others have considered it a variety of *U. changii* (Li, 1982; Wu, 1984; Fu & Xin, 2000; Fu et al., 1998, 2003). In fact, *U. kunmingensis* is easily distinguished from *U. changii* by its flowers from mixed buds, scattered in basal or sub-basal bract axils on young branches and its leaf blades that abaxially bear tufted hairs in axils of veins. In contrast, *U. changii* is distinguished by its flowers in fascicled cymes from floral buds, not mixed buds, and its leaf blades being either glabrous or pubescent along the veins. Given this morphological distinction, we therefore prefer to treat *U. kunmingensis* as a distinct taxon at the rank of species.

However, until now, the invalidity of Cheng's name was not recognized in recent floristic works. The present paper validates the name *Ulmus kunmingensis* under Article 33.1 (McNeill et al., 2012) by designating *T. C. Chao 1516* as type. The selected holotype is a specimen with fruits in the herbarium NF and was cited in the original publication. The fruiting collection is preferred over the flowering one (*Cheng 11002*), both mentioned by Cheng (Cheng et al., 1963: 12), because fruit is one of the significant diagnostic characters to identify species in *Ulmus*. Validation is also supported by direct reference to Cheng's Latin description (Cheng et al., 1963: 12). The flowering collection, *W. C. Cheng 11002*, is designated as the paratype. We ascribe the name, *U. kunmingensis* to the original describing author, W. C. Cheng, which is supported by Article 46.2 (McNeill et al., 2012).

Ulmus kunmingensis W. C. Cheng, sp. nov. *Ulmus kunmingensis* W. C. Cheng, Sci. Silvae Sin. 8(1): 12. 1963, nom. inval. TYPE: China. Yunnan: Kunming, Xishan, 20 Mar. 1934 (fr.), *T. C. Chao 1516* (holotype, NF; isotype, PE).

Distribution and habitat. *Ulmus kunmingensis* is endemic to China, occurring in Guangxi, Guizhou, Sichuan, and Yunnan provinces. It is known from forests at altitudes from 600 to 1800 m.

Paratype. CHINA. **Yunnan:** Kunming, Xishang, May 1942 (fl.), *W. C. Cheng 11002* (NF, PE).

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A New Species of *Boechera* (Brassicaceae) from the Primorsky Territory, Russia

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Abstract. *Boechera calcarea* Dudkin, a new species of Brassicaceae from the Primorsky Territory, Russia, is described and illustrated. In morphology the new species, *B. calcarea*, resembles *B. falcata* (Turcz.) Al-Shehbaz, but the latter can be differentiated by the narrow fruit, pubescent stem, and smaller flowers and seeds. Corolla color in *B. calcarea* is pale lavender, whereas in *B. falcata* it is pink-violet. *Boechera calcarea* is distinguished by its pale lavender petals, forked trichomes, and larger fruit. Based on its distribution in the Chandalaz (Lozovy) mountain range, the new taxon is likely an obligate calciphile.

Key words: *Boechera*, Brassicaceae, IUCN Red List, Russia.

Among the Brassicaceae in the Russian Far East, there are four species of *Arabis* L., s.l., two of which, *A. pendula* L. and *A. hirsuta* (L.) Scop., occur in the Primorsky Territory (Berkutenko, 1988). The genus *Boechera* Á. Löve & D. Löve was initially established in 1976, and no species have yet been noted from the region. The genus was treated as a synonym of *Arabis* by subsequent authors (e.g., Mulligan, 1996; Kartesz, 1999). However, recent molecular analyses by Koch et al. (2001) and Al-Shehbaz (2003) reveal that *Boechera* and *Arabis* belong to distantly related clades of Brassicaceae that diverged ca. 19 to 25 million years ago. Morphological similarities between these groups were caused by evolutionary convergence rather than shared ancestry, and the new classification of the family (Al-Shehbaz et al., 2006) places *Arabis* and *Boechera* in different tribes. In the course of botanical research a population of a new species of *Boechera* was found on limestone outcrops in the Primorsky Territory, in the Chandalaz (Lozovy) Range. The Chandalaz Range is the largest calcareous massif in the Russian Far East and is a refugium for many rare species of plants (Doudkin, 1998).

Recent research on *Arabis* specimens collected on the limestone outcrops in the Primorsky Territory and those at the Herbarium of the Botanical Institute (LE) made it possible to reveal the taxonomic identity of *Arabis* specimens collected by I. Shishkin on the Chandalaz Range as early as in 1929. There is no doubt those specimens belong to the new species described herein, with all the characters, including the fruit size and orientation, the leaf shape, and the pubescence pattern, indicating this.

The new species is described within the genus *Boechera*, sharing the diagnostic combination of erect or divaricate fruits (not second) and primarily stalked trichomes. Beyond the morphological correspondence, the diploid chromosome number as counted by us was $2n = 14$ (cf. Fig. 1), which corresponds to the base chromosome number of $x = 7$ for the genus *Boechera* (Al-Shehbaz, 2005; Al-Shehbaz et al., 2006). *Boechera falcata* (Turcz.) Al-Shehbaz [≡ *Arabis falcata* Turcz.; syn. = *A. turczaninowii* Ledeb.], which occurs in the northern Far East, is the only species of the genus *Boechera* noted to date from Northeast Asia. Its chromosome number was also confirmed as $2n = 14$ (Yurtsev & Zhukova, 1972; Berkutenko & Gurzenkov, 1976). Chromosome counts for other similar *Arabis* species in northeastern Asia may indicate additional names to segregate to *Boechera*, since the base chromosome number for *Arabis* s. str. is $x = 8$.

Boechera calcarea Dudkin, sp. nov. TYPE: Russia. Primorsky Territory: Partizansky Distr., Chandalaz (Lozovy) Range, the northern part, on limestone rocky slopes of Chertov Cliff Peak, 12 June 2004, *R. V. Doudkin s.n.* (holotype, LE; isotypes, VBGI, VLA). Figures 1, 2.

Haec species *Boecherae falcatae* (Turcz.) Al-Shehbaz similis, sed ab ea siliqua longiore latioreque, petalis pallide violaceis atque caulis trichomatibus stellatis vel furcatis differt.

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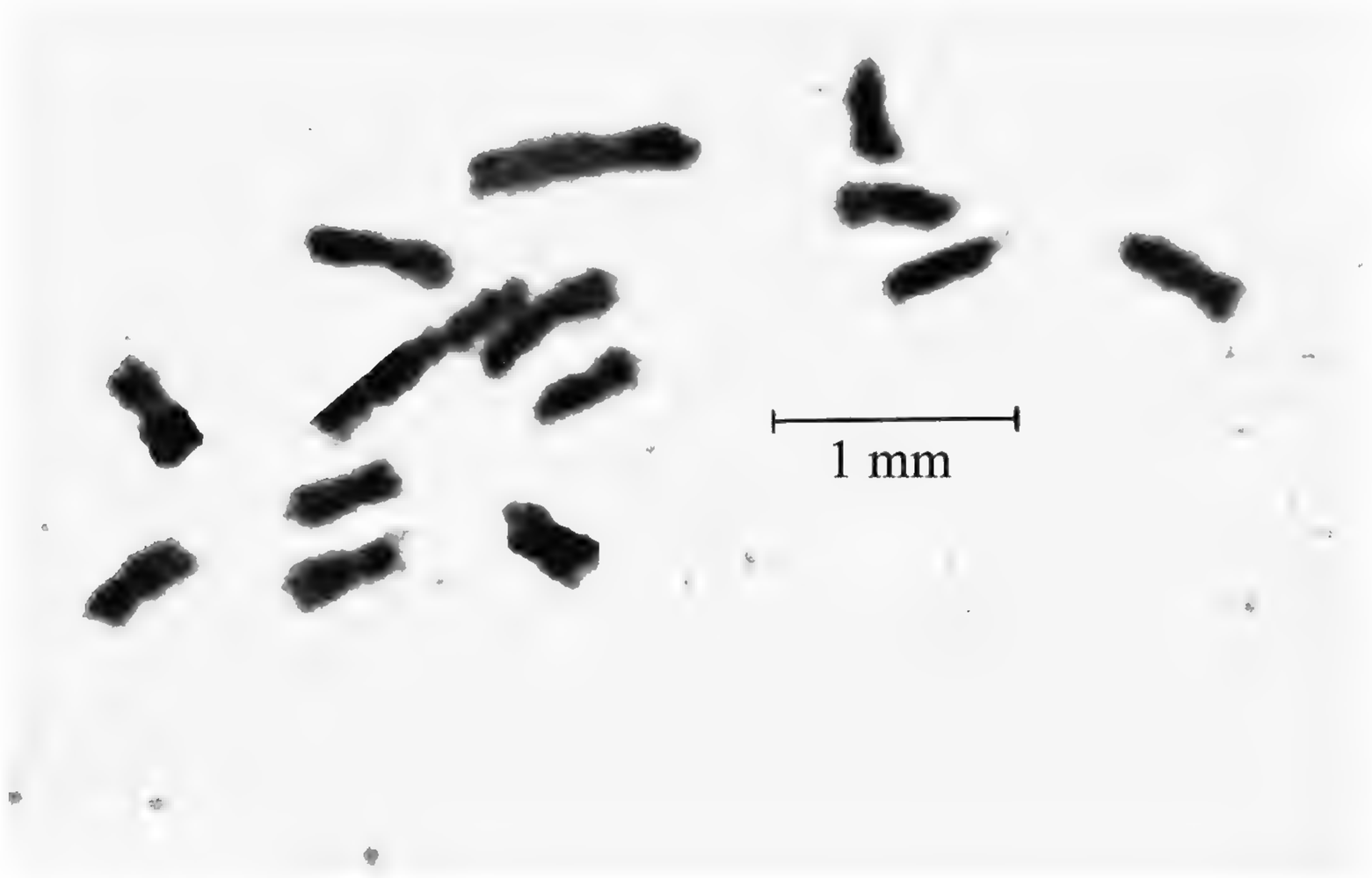

Figure 1. *Boechera calcarea* Dudkin. Chromatids at meiotic metaphase, $2n = 14$. Taken from the paratype from Mt. Sestra, limestone rock near summit, 16 July 2008, *R. V. Doudkin s.n.* (BGI).

Herbs biennial, (10)20–35(50) cm tall, densely to sparsely hirsute, with stalked or forked trichomes mixed at least basally with varying amounts of simple ones; stems erect, simple or few from base, often branching at middle portion of stems. Basal leaves rosulate, present at anthesis; petiole absent, but rarely distinct, to 2.5 cm; leaf blades on the stem oblanceolate, narrowly obovate, or lanceolate, (2)3–7(9) × (1)1.5–2.5(3) cm, base attenuate, margin dentate, or rarely serrate, apex obtuse or acute; middle cauline leaves sessile, oblong, ovate, or elliptic, rarely suboblanceolate, (0.7–)1.5–4(–6) × (0.2–)0.4–1.4(2.5) cm, with forked trichomes, sometimes mixed adaxially with simple ones, blade bases cordate or auriculate, margin dentate or entire, apex obtuse or acute. Racemes ebracteate; fruiting pedicels divaricate, rarely ascending or slightly reflexed, (0.5)0.8–1.8(–2.3) cm, slender, straight or rarely slightly curved. Sepals oblong or sublanceolate, 2.5–3.5(4) × 1–1.5 mm, glabrous or sparsely pubescent, not saccate; petals pale lavender, oblong or narrowly oblanceolate, 4–6(6.5) × 1–2 mm, apex obtuse; filaments 3.5–5 mm; anthers oblong, 0.8–1 mm; style 0.4–0.8 mm; ovules 38 to 85 per ovary. Fruit (3.5)4–8.5(10) × 0.15–0.2 cm, erect or divaricate or rarely reflexed, not appressed to rachis; valves with a distinct midvein, torulose, glabrous; seeds brown, oblong or ovate, 1.3–1.7 × 0.8–1.1 mm, narrowly winged on distal half.

Habitat and distribution. *Boechera calcarea* was originally collected from limestone rocky slopes and observed at elevations from 250 to 600 m within the Lozovy (Chandalaz) mountain range. It is considered endemic to the Partizansky District located in southern Primorsky Krai, Russia. The taxon has been later collected on Mt. Sen'kina Shapka and Mt. Sestra in the same district, which is located in southern Primorsky Territory.

Phenology. *Boechera calcarea* was observed to flower and fruit from May to July.

Paratypes. RUSSIA. **Primorsky Terr.:** Souchan Distr., Mt. Chandalaz, rocky outcrop, 600 m, 18 July 1929, *I. Shishkin s.n.* (LE); Mt. Sen'kina Shapka, limestone rocky outcrop, 3 July 1971, *V. Verkholat 8149* (BGI); Mt. Sestra, limestone rock near summit, 16 July 2008, *R. V. Doudkin s.n.* (BGI).

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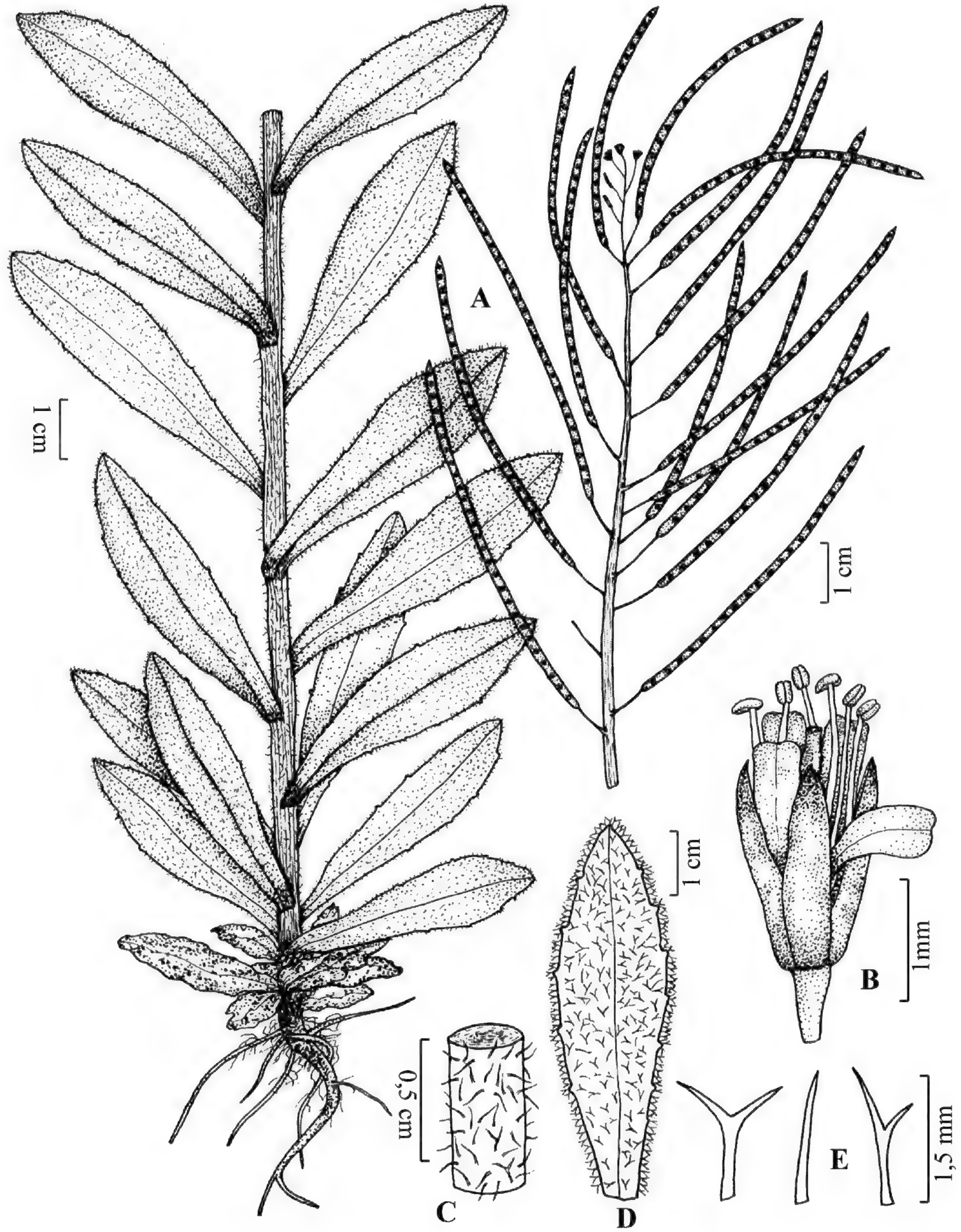

Figure 2. *Boechera calcarea* Dudkin. —A. Fertile plant showing the basal rosette of leaves present at anthesis. —B. Flower. —C. Basal portion of stem. — D. Stem leaf blade. —E. Representative trichomes from stem and leaf. Drawn from the type *R. V. Doudkin s.n.* (LE).

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Aristea (Iridaceae, Aristeoideae), a Subgeneric Classification

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Abstract. A novel classification here of the sub-Saharan and Madagascan genus *Aristea* Aiton (Iridaceae), with ca. 57 species, recognizes three subgenera, *Aristea* subg. *Aristea* (18 species), *Aristea* subg. *Eucapsulares* (Goldblatt) Goldblatt [≡ *Aristea* sect. *Eucapsulares* Goldblatt] (ca. 30 species), and *Aristea* subg. *Pseudaristea* (Pax) Goldblatt [≡ *Aristea* sect. *Pseudoaristea* Pax] (nine species). This replaces a 1940 classification by Henning Weimarck, which included eight sections. In this updated classification, *Aristea* subg. *Aristea* includes three sections, and *Aristea* subg. *Eucapsulares*, two sections. A lectotype, *A. spiralis* (L. f.) Ker Gawl., is designated for *Aristea* sect. *Pseudaristea* Pax [≡ *Aristea* subg. *Pseudoaristea* (Pax) Goldblatt].

Key words: *Aristea*, Iridaceae, Madagascar, sub-Saharan Africa.

In past and current studies of the African and Madagascan *Aristea* Aiton (ca. 57 species), the only genus of subfamily Aristeoideae (Goldblatt & Manning, 2008) of the Iridaceae, my colleagues and I proposed an infrageneric classification that remains to be validly published (Goldblatt & Le Thomas, 1997; Goldblatt et al., 2004). This classification treats the genus as comprising three subgenera: (1) *Aristea* subg. *Aristea* is restricted to the southern African winter-rainfall zone (the Greater Cape Flora Region); (2) *Aristea* subg. *Pseudaristea* (Pax) Goldblatt, restricted to the Core Cape Flora Region of South Africa; and (3) *Aristea* subg. *Eucapsulares* (Goldblatt) Goldblatt, widespread across sub-Saharan Africa, including Madagascar.

These three subgenera in *Aristea* receive support as monophyletic clades in phylogenetic studies using morphology, palynology, and the fine structure of seeds, all of which correlate closely (Goldblatt et al., 2004; Goldblatt & Manning, 2008). No molecular DNA sequence studies within *Aristea* have been undertaken to date. Henning Weimarck (1940), in a revision of the genus, recognized 49 species in eight sections but no subgenera. Four of his sections, *Aristea* sect. *Ancipites* Weim., *Aristea* sect. *Cladocarpae* Weim., *Aristea* sect. *Euaristea* Pax (this not including the type of *Aristea* and not admissible according to the International Code of Botanical Nomenclature, cf. Art. 21.3, McNeill et al., 2006), and *Aristea* sect. *Trilobatae* Weim., fall within subgenus *Eucapsulares*. An additional section, *Aristea* sect. *Pseudaristea* Pax, is now recognized as subgenus *Pseudaristea*, and the remaining three, *Aristea* sect. *Cyaneae* Pax (which included the type of the genus and automatically becomes *Aristea* sect. *Aristea*), *Aristea* sect. *Racemosae* Weim., and *Aristea* sect. *Singulares* Weim., constitute subgenus *Aristea*. The composition of Weimarck's sections differs to some degree from that outlined by Goldblatt et al. (2004). Most significantly, *A. ecklonii* Baker and *A. pusilla* (Thunb.) Ker Gawl. were removed by Goldblatt et al. (2004) from *Aristea* sect. *Pseudaristea* to *Aristea* sect. *Eucapsulares*. A revised sectional classification of subgenus *Eucapsulares* remains to be developed. The composition of the subgenera and sections, as listed below, was first outlined in a previous phylogenetic study (Goldblatt et al., 2004).

Aristea [Sol. in] Aiton, Hort. Kew. 1: 67. 1789. TYPE: *Aristea africana* (L.) Hoffmanns.

Cleanthe Salisb. ex Benth. & Hook., Gen. Pl. 3: 684, 701. 1883 [*Cleanthe* Salisb., Trans. Hort. Soc. London 1: 312. 1812, nom. inval., sine descr.]. TYPE: *Cleanthe melaleuca* Salisb. ex Pax, Nat. Pflanzenfam. [Engler & Prantl] 2(5): 152. 1888, nom. nov., pro *Moraea melaleuca* Thunb., nom. illeg. superf.].

Aristea ser. *Cleanthe* Baker, J. Linn. Soc., Bot. 16: 112. 1877 [14 July 1877]. TYPE: *Aristea melaleuca* Ker Gawl. nom. nov. et nom. superfl. pro *Moraea lugens* L. f. [= *A. lugens* (L. f.) Weim.].

I. Aristea Aiton subg. **Aristea**.

There are 18 species in three sections: *Aristea* sect. *Singulares* (one species), *Aristea* sect. *Aristea* (six species), and *Aristea* sect. *Racemosae* (11 species).

Flowers deep blue, always fugaceous, lasting 1 morning; capsules usually about as short as wide, (rarely longer than wide), with narrow, radial wings or deeply 3-lobed (*Aristea* sect. *Singulares*); seeds tangentially compressed, less so in *A. singularis* Weim.; pollen grains mostly monosulcate or trisulcate (*Aristea* sect. *Aristea*), with smooth aperture, exine reticulate.

1. Aristea Aiton sect. **Aristea.**

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Species included (6): *Aristea africana*, *A. dichotoma* (Thunb.) Ker Gawl., *A. glauca* Klatt, *A. oligocephala* Baker, *A. palustris* Schltr., and *A. recisa* Klatt.

2. Aristea sect. **Racemosae** Weim., Acta Univ. Lund., 2, 36(1): 70. 1940. TYPE: *Aristea racemosa* Baker.

Species included (11): *Aristea bakeri* Klatt, *A. bracteata* Pers., *A. capitata* (L.) Ker Gawl., *A. cuspidata* Schinz, *A. fimbriata* Goldblatt & J. C. Manning, *A. inaequalis* Goldblatt & J. C. Manning, *A. juncifolia* Baker, *A. racemosa*, *A. rigidifolia* G. J. Lewis, *A. rupicola* Goldblatt & J. C. Manning, and *A. zeyheri* Baker.

3. Aristea sect. **Singulares** Weim., Acta Univ. Lund., 2, 36(1): 12. 1940. TYPE: *Aristea singularis* Weim.

Species included (1): *Aristea singularis*.

II. Aristea subg. **Eucapsulares** Goldblatt, stat. nov. *Aristea* sect. *Eucapsulares* Goldblatt in Bull. Mus. Natl. Hist. Nat., B, Adansonia, Sér. 4, 14(2): 228. 1992 [1993], replacement name for *Aristea* sect. *Euaristea* Pax, Nat. Pflanzenfam. [Engler & Prantl] 2(5): 152 (1888), nom. inval. TYPE: *Aristea angolensis* Baker.

This subgenus includes 30 species in two sections: *Aristea* sect. *Latifolieae* Goldblatt (1) and *Aristea* sect. *Eucapsulares* Goldblatt (29).

Flowers always fugaceous, lasting 1 morning; capsules short and ovoid to ovoid-trigonous or elongate-trigonous; seeds ovoid to angular-prismatic to shortly cylindric; pollen grains occasionally shed as tetrads, mostly zonasulculate with aperture concealed by exine masses, exine rugulate, rarely reticulate.

1. Aristea sect. **Eucapsulares** Goldblatt, Bull. Mus. Natl. Hist. Nat., B, Adansonia, Sér. 4, 14(2): 228. 1992 [1993], replacement name for *Aristea* sect. *Euaristea* Pax, nom. inval. TYPE: *Aristea angolensis* Baker (lectotype, designated by Goldblatt & Le Thomas [1992: 228]).

Species included (29): *Aristea abyssinica* Pax, *A. alata* Baker, *A. anceps* Eckl., *A. angolensis*, *A. angustifolia* Baker, *A. bequaertii* De Wild., *A. cladocarpa* Baker, *A. compressa* Buch. ex Baker (including *A. gerrardii* Weim.), *A. djalonis* Hutch. (included by Weimarck, 1940, in *A. angolensis*), *A. ecklonii*, *A. elliptica* Goldblatt & A. P. Dold, *A. ensifolia* Muir, *A. farafangana* Goldblatt & Phillipson, *A. flexicaulis* Baker, *A. goetzei* Baker, *A. grandis* Weim. (including *A. galpinii* N. E. Br. ex Weim.), *A. humbertii* H. Perrier, *A. kitchingii* Baker, *A. madagascariensis* Baker, *A. nana* Goldblatt & J. C. Manning, *A. parviflora* Baker, *A. platycephala* Baker, *A. montana* Baker, *A. nyikensis* Baker, *A. polycephala* Harms, *A. pusilla*, *A. ranomafana* Goldblatt, *A. schizolaena* Harv. Ex Baker, and *A. torulosa* Klatt (= *A. woodii* N. E. Br.).

2. Aristea sect. **Latifolieae** Goldblatt, Bot. J. Linn. Soc. 144(1): 64. 2004. TYPE: *Aristea latifolia* G. J. Lewis.

Species included (1): *Aristea latifolia*.

III. Aristea subg. **Pseudaristea** (Pax) Goldblatt, stat. nov. *Aristea* sect. *Pseudaristea* Pax, Nat. Pflanzenfam. [Engler & Prantl] 2(5): 153. 1888. TYPE: *Aristea spiralis* (L. f.) Ker Gawl., Ann. Bot. [König & Sims] 1(2): 236. 1804 (lectotype, designated here).

This subgenus includes nine species; no sections are recognized pending further investigation. Of the two species listed in the protologue of *Aristea* sect. *Pseudaristea* by Pax, I designate *A. spiralis* the lectotype. It accords best with the circumscription, and in addition I regard *A. pusilla* as belonging in subgenus *Eucapsulares*.

Flowers deep blue and fugaceous in one species, or pale blue, cream or white, then with contrasting markings and lasting at least 1 full day or 2 days; capsules elongate, trigonous, tardily dehiscent; seeds columnar-triangular; pollen grains dizonasulculate, exine reticulate.

Species included (9): *Aristea biflora* Weim., *A. cantharophila* Goldblatt & J. C. Manning, *A. cistiflora* J. C. Manning & Goldblatt, *A. lugens*, *A. nigrescens* Goldblatt & J. C. Manning, *A. pauciflora* W. Dod., *A. simplex* Weim., *A. spiralis*, and *A. teretifolia* Goldblatt & J. C. Manning.

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Typification of the Name *Kochia saxicola* (Chenopodiaceae)

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ABSTRACT: The typification of the name *Kochia saxicola* Guss. [= *Eokochia saxicola* (Guss.) Freitag & G. Kadereit] (Chenopodiaceae) is here discussed, and a specimen from the Gussone collection (NAP) is designated as the lectotype. The distribution of the species is given and remarks on its IUCN conservation status are provided.

Key words: Chenopodiaceae, *Eokochia*, Italy, IUCN Red List, *Kochia*.

Recent molecular, morphological, and biogeographical studies of the tribe Camphorosmeae in the Chenopodiaceae (Kadereit & Freitag, 2011) revealed three major lineages, informally named as the *Chenolea* Thunb., *Sclerolaena* R. Br., and *Bassia–Camphorosma* clades. The phylogenetic analyses showed that all nonmonotypic genera, except *Camphorosma* L. and *Neokochia* (Ulbr.) G. L. Chu & S. C. Sand., were polyphyletic. Among these, *Bassia* All. [= *Kochia* Roth] was split into five clades and four new genera: *Eokochia* Freitag & G. Kadereit, *Grubovia* Freitag & G. Kadereit, *Sedobassia* Freitag & G. Kadereit, and *Spirobassia* Freitag & G. Kadereit. *Eokochia* belongs to the *Chenolea* clade, which consists of four disjunctly distributed and morphologically divergent genera with this group altogether comprising only five species: the monotypic *Chenolea* from South Africa; the monotypic *Spirobassia* from Europe to South Siberia; *Neokochia*, with two species in North America; and *Eokochia*, whose single species is a rare endemic of the area surrounding the Tyrrhenian Sea west of Italy. Kadereit and Freitag (2011) concluded that these four genera are the remnants of an old lineage, which suffered extensive extinction, and that their present-day ecology might represent the ancestral ecology of the entire tribe Camphorosmeae. *Eokochia saxicola* (Guss.) Freitag & G. Kadereit is a subshrub, growing on coastal cliffs exposed to sea spray. The leaves are strongly succulent and almost terete. The species has single flowers in the axils of regular leaves and the persistent perianth shows five distinct wings in the fruiting stage (Fig. 1).

The new monotypic genus *Eokochia* Freitag & G. Kadereit is based on *Kochia saxicola* Guss. (Gussone, 1855) which is, as far as we are aware, yet untypified.

This study is part of the research work carried out by one of the authors (D. Iamonico) for the project "Taxa of vascular plants described from Italy: Inventory, typification, and biosystematic investigations" under the auspices of the Italian Botanic Society (e.g., Iamonico, 2010, 2012a, 2012b, 2012c, 2013; Iamonico et al., 2011; Iamonico & Jarvis, 2012; Iamonico & Peruzzi, 2012; Iamonico & Reveal, 2012).

Eokochia saxicola (Guss.) Freitag & G. Kadereit, Taxon 60(1): 72. 2011. Basionym: *Kochia saxicola* Guss., Enum. Pl. Inarim.: 275. 1855. *Bassia saxicola* (Guss.) A. J. Scott, Feddes. Repert. 89: 108. 1978. TYPE: [Italy. Campania:] "Campania, Ischia né scogli di S. Anna," 10 Aug. 1850, *G. Gussone s.n.* (lectotype, designated here, NAP). Figure 1.

In order to select an adequate lectotype for *Eokochia saxicola*, the specimens collected by G. Gussone in BI, CAT, FI, NAP, PAL, and RO were examined (acronyms according to Thiers, 2011). Gussone's collections came from two islands in the Tyrrhenian Sea: Ischia (locus classicus) and Capri (Campania region). Most were collected after the year 1855, so they cannot be chosen as the lectotype (see Art. 9.3 of the ICN; McNeill et al., 2012). Two specimens (kept in NAP) are from 1850 and each includes two fragments and one label. Both labels report the locality "Ischia né scogli di S. Anna," which matches the locus classicus by Gussone (1855). However, one of the specimens (collected on 28 May 1850) bears a plant without an inflorescence, the structure of which is important to the identification of the species. The other, collected on 10 Aug. 1850, is a good specimen, bearing two parts of one plant whose features (both sexual and vegetative characters) are in accordance with the

Figure 1. Lectotype of *Kochia saxicola* Guss (*G. Gussone s.n.*, NAP) .

protologue. After the diagnosis Gussone (1855) cited a reference to an "Ic. [Iconography] nostra T. XIII." This plate shows a detailed drawing that includes a portion of the plant with both sterile and fertile branches and details of flowers and seeds. The illustration can be considered original material and perfectly matches the protologue.

Among these selected elements (specimens from Gussone's collection in NAP and the illustration by Gussone), we prefer to choose one of the specimens

against the plate, after consideration of Articles 40.4 and 38.8 (McNeill et al., 2012). Because the exsiccata collected on 10 Aug. 1850 includes fruits, it better represents Gussone's concept of the species. Therefore, it is here selected as the lectotype of the name *Eokochia saxicola*.

Distribution. *Eokochia saxicola* is recorded from the Campania and Sicilia regions in southern Italy. The species was first described by Gussone (1855: 275) from Campania with the detail "In aridissimis rupibus maritimis; Ischia ne' scogli di S. Anna, e propriamente nel pendio orientale di uno solo di essi più prossimo alla terra, e vicino a quello detto a tre pizzi." [On arid slopes by the sea; Ischia in the rocks of S. Anna, and on the eastern slope of one of them next to the ground, and close to the one named a tre pizzi]. Other reports followed from the same region, such as Cesati et al. (1884) on Ischia Island and Guadagno (1926: 252) who reported the species on Capri Island "Sulle rocce presso il mare...Bagni di Tiberio" [on the rocks by the sea...Bagni di Tiberio] and "in rocce presso la Grotta Azzurra" [rocks near the Grotta Azzurra]. Guadagno (1926: 252) also indicated that the species had not been subsequently found because the site has been buried by calcareous debris. The same localities were quoted in subsequent works (Guadagno, 1931a, 1931b, 1931c, 1932a, 1932b, 1932c). Migliorato (1896) and Cerio and Bellini (1900) confirmed the occurrence on Capri. Béguinot and Landi (1930), Cerio (1939), and Davis (1951) indicated the extinction of *E. saxicola* from Capri. Recently, Ricciardi (1996) found a population of about 100 individuals on Capri, but concluded that it was extinct on Ischia. The floristic surveys by Ricciardi et al. (2004) confirmed the observations of Ricciardi (1996).

The first record of the species in the Sicilia region was by Lojacono Pojero (1902) from Strombolicchio, an islet near Stromboli of the Aeolian Islands, but only one individual was found. The last floristic survey was by Ferro and Furnari (1968a: 33, 1968b) who reported that "Rari esemplari sono stati da noi rinvenuti sulla parete settentrionale dell'isolotto di Strombolicchio." [Rare individuals were found on the northern cliff of the islet of Strombolicchio.] Giardina et al. (2007) repeated the quotations of Lojacono Pojero (1902) and Ferro and Furnari (1968a: 33, 1968b) and emphasized that the species was "in danger of extinction."

The comprehensive works on Italian flora (Arcangeli, 1882, 1894; Fiori & Paoletti, 1896–1898; Fiori, 1925; Zangheri, 1976; Pignatti, 1982; Conti et al., 2005) overtook the localities recorded in the local floras, except for that from Caruel (1893), which did not include *Eokochia saxicola*.

IUCN Red List category. *Eokochia saxicola* has been previously evaluated as Critically Endangered (CR) according to Conti et al. (1997) and Scoppola and Spampinato (2005). More recently (Santangelo et al., 2012), the species was evaluated as Endangered (EN) under the criterion B. At present *E. saxicola* can be considered one of the rarest plants in Europe. On the island of Ischia, a few individuals were recently reintroduced in the locus classicus from plants successfully cultivated in the Botanic Garden of Napoli (G. & V. Vallariello, pers. comm.).

Specimens examined. ITALY. **Campania:** Ischia né scogli di S. Anna, 10 Aug. 1850, *G. Gussone s.n.* (NAP); In insula Caprearum, 10 Sep. 1865, *Kuntze s.n.* (FI); Ischia, 30 May 1868, *N. A. Pedicino s.n.* (RO [2]); Ischia, Scogli di S. Anna, Aug. 1868, *coll. s.n.* (RO); Scogli di S. Anna, Aug. 1868, *N. A. Pedicino s.n.* (PAL, RO); ex insula Inarime, 8 Sep. 1875, *E. Levier s.n.* (FI [5], RO, WU); Ischia, s.d. [19th century], *G. Gussone s.n.* (RO); Capri, 26 Oct. [19th century], *C. Lacaita s.n.* (FI); Ischia, s.d. [19th century], *E. Levier s.n.* (FI); Ins. Inarime (Ischia), s.d. [19th century], *N. A. Pedicino s.n.* (RO [5]). **Sicilia:** Strombolicchio, s.d. [ante 1865], *L. Salvadore s.n.* (FI).

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Casearia maynacarpa (Salicaceae), a New Name for *Carpotroche parvifolia*

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Abstract. A new name is proposed for *Mayna parvifolia* (J. F. Macbr.) Sleumer [≡ *Carpotroche parvifolia* J. F. Macbr.]; the species belongs in *Casearia* Jacq. (Salicaceae). However, the basionym name *Casearia parvifolia* Tul. has already been used twice by both Willdenow and Tulasne, and we therefore establish *Casearia maynacarpa* Liesner & P. Jørgensen as a replacement name.

Key words: Bolivia, *Carpotroche*, *Casearia*, Madagascar, *Mayna*, Peru.

During the preparation of the Salicaceae for the catalogue of Bolivian vascular plants, we discovered that a name was missing for numerous specimens from Peru and Bolivia of what so far have been called *Mayna parvifolia* (J. F. Macbr.) Sleumer. The species was originally based on fruiting material by Macbride (1932) in the genus *Carpotroche* Endl., but it belongs in *Casearia* Jacq. The three genera in question are easily distinguished by the following morphological characters: The number of styles range from one in *Casearia*, to two to five in *Mayna* Aubl., to four to eight in *Carpotroche*. The number of petals and sepals is identical (five) in *Casearia*, whereas *Mayna* and *Carpotroche* have more petals than sepals. The fruit in *Casearia* is a capsule that splits into three(four) valves; in *Carpotroche*, the fruit is also a capsule, but one that splits late, and maybe only if pressed, into three to five(to seven) valves. In *Mayna*, the fruit is an indehiscent berry that occasionally splits distally, perhaps also as an effect of pressing. *Casearia* has no pulvinus associated with the leaves, while both *Mayna* and *Carpotroche* do. The leaves in *Casearia* are elliptic and widest at the middle while usually obovate in *Mayna* and *Carpotroche*. *Casearia* has leaf blades that are pellucid linear punctate, which does not occur in *Mayna* or in *Carpotroche* (Sleumer, 1980). The placement of the species in the correct genus would not be problematic if flowering material were available, but even sterile and fruiting specimens have enough characters to safely and correctly place them in *Casearia*. Macbride (1934: 390) stated: "I venture to describe it even in the absence of flowers," but he was somewhat uncertain of its placement, noting that "the leaves are exceptionally small for the genus, suggesting more the related group *Mayna*." Sleumer (1938) was confident in moving the species to *Mayna*, but provided no argument or morphological character to support the move. Subsequently, he indicated that the flowers are unknown (Sleumer, 1980), but had evidently seen only four collections. We have now seen 33 collections and still have not encountered flowering specimens; all material are either sterile or fruiting. However, the species undoubtedly belongs to the genus *Casearia* despite the fruit having long projections, as many species of *Mayna* and *Carpotroche* do. This is the sole character that the species has in common with these two genera, and a number of exceptions to the circumscription of *Mayna* will disappear with the suggested realignment, such as the appearance of linear glands on leaves, the thick dehiscent capsular fruits with three valves, and the absence of a pulvinus.

Casearia maynacarpa Liesner & P. Jørgensen, nom. nov. Replaced name: *Carpotroche parvifolia* J. F. Macbr., Candollea 5: 390. 1934, non *Casearia parvifolia* Willd., Sp. Pl., Ed. 4: 628. 1799, nom. illeg., nec *Casearia parvifolia* Tul., Ann. Sci. Nat., Bot., sér. 5, 9: 328. 1868, nom. illeg. *Mayna parvifolia* (J. F. Macbr.) Sleumer, Repert. Spec. Nov. Regni Veg. 45: 12. 1938. TYPE: Peru. Loreto: Puerto Arturo, Yurimaguas, s.d., (fr.) *L. Williams 5260* (holotype, F, F photo 50666; isotypes, G, G fragm. ex F, US).

A combination based on *Carpotroche parvifolia* in *Casearia* is blocked because the epithet has already been used in the genus twice. The oldest name by Willdenow from 1799 is illegitimate because it places *C. decandra* in synonymy and is thereby in conflict with Principle III of the Melbourne Code (McNeill et al., 2012). The second name by Tulasne from 1868 is a later homonym, for which a replacement name was proposed by Baillon in 1886 in *Guidonia* Mill., which was subsequently transferred into *Casearia* as *C. tulasneana* (Baill.) Warb.

Specimens examined. BOLIVIA. **La Paz:** Comunidad de Santa Fe, 4 km N de la comunidad, bosque amazónico entre sabanas húmedas, *DeWalt et al. 509* (MO); *DeWalt et al. 659* (MO), *DeWalt & Racua 847* (MO); Comunidad de Buena Vista, 3 km NE de la comunidad, bosque húmedo de llanura, *DeWalt & Serato 891* (MO); Madidi, Rio Tuichi, Laguna Chalalán, *Araujo et al. 541* (LPB, MO), *Araujo et al. 600* (LPB, MO). BRAZIL. **Acre:** Bacia do Rio Purus, Faz. Nova Olinda, Carreador do Porti, Ramal do Cumaru, ca. 12 km da sede, floresta primária; terreno ondulado, *Silveira 606* (MO). PERU. **Loreto:** Rio Aguaytia ca. 3 bends above jct. with Rio Ucayali, mature lowland rainforest, *McDaniel 14021* (MO). **Madre de Dios:** Distr. Tambopata, Rio Madre de Dios, Albergue Reserva Amazónica, bosque primario tropical lluvioso, *Monteagudo et al. 6221* (MO, USM); Las Piedras, Cusco Amazónico, *Timaná & Jaramillo 3294* (MO); Cusco Amazónico, Río Madre de Dios below Puerto Maldonado, mature forest on alluvial soil, *Gentry & Núñez 65999* (MO); Cusco Amazónico, 15 km ENE of Puerto Maldonado, *Gentry 68613* (MO), *Gentry et al. 68913* (MO); Tambopata Tourist Camp, jct. of Río La Torre & Río Tambopata, *Gentry et al. 78140* (MO); Alrededores del Albergue turístico Cusco Amazónico, margen izquierdo del Río Madre de Dios, ca. 35 km de Puerto Maldonado, *Núñez et al. 10010* (MO); Cusco Amazónico, Lodge camp site 1, *Núñez et al. 10773* (MO); Manu Park, Cocha Cashu uplands, *Núñez 5668* (MO); Las Piedras, Cusco Amazónico, a lo largo de la Quebrada Gamitana, límite este de la reserva, bosque primario, *Timaná & Smith 1493* (MO); Las Piedras, Albergue Cusco Amazónico, zona inundable (pantano), bosque primario, levemente perturbado con árboles de hasta 50 m, suelos ricos, *Timaná & Smith 1264* (MO), *Timaná & Smith 1279* (MO); Las Piedras, Cusco Amazónico, principalmente bosque secundario tardío, *Timaná & Jaramillo 2383* (MO); Cocha Nueva, Río Manu, 10 km upstream from Cocha Cashu, *Núñez 6937* (MO); Cocha Cashu Camp, Manu National Park, *Gentry et al. 27073* (MO); Comunidad Nativa Infierno, Hermosa Chica, *Alexiades & Pesha 323* (MO); Tambopata Reserve, jct. of Río La Torre & Río Tambopata, trail from Río Tambopata to Tres Chimbadas Lagoon, *Young 156* (MO). **Ucayali:** Bosque Nacional Alexander von Humboldt. Pucallpa–Tingo María Rd., carretera de extracción, *Fröhner 78* (MO); Bosque Nacional von Humboldt, Km. 88 Pucallpa–Tingo María rd., "carretera de extracción," N of main rd., disturbed forest on lateritic soil, *Gentry et al. 36383* (MO); Km. 86, cerca al arboreto A. von Humboldt, *Encarnación 26417* (MO); Bosque Nacional Von Humboldt, boerde de la carretera hacia los campamentos, *Díaz et al. 703* (MO); Quebrada Shesha, 1.30 hr. de la boca del Shesha hacia arriba, *Díaz et al. 833* (MO). **Huanuco:** Carretera marginal entrando por Von Humboldt, localidad Dantas, trocha de estudio, terreno arenoso-arcilloso, *Díaz & Baldeón 2300* (MO).

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Tropidia namasiae, a New Species of Orchidaceae (Epidendroideae, Tropidieae) from Southwestern Taiwan

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ABSTRACT. *Tropidia namasiae* C. K. Liao, T. P. Lin & M. S. Tang, a new species of *Tropidia* Lindl. (Orchidaceae, Epidendroideae, Tropidieae) from the Namasia District in southwestern Taiwan, is described and illustrated. The species is mainly characterized by its subopposite and ovate to lanceolate leaves and dorsal sepals (3.5–4 mm), the smallest observed among species of *Tropidia* in Taiwan. The new species is closely related to *T. angustifolia* C. L. Yeh & C. S. Leou, but differs in leaf shape, size, and number as well as the number of flowers per raceme. Morphological similarities between these two species can be seen in the shapes of the floral lip and column, as well as lengths of the leaf blades. A key to the six species of *Tropidia* in Taiwan is also provided.

Key words: Epidendroideae, IUCN Red List, Orchidaceae, Taiwan, *Tropidia*, Tropidieae.

Tropidia Lindl. is a tropical genus (Orchidaceae, Epidendroideae, Tropidieae) with 20 to 40 species that is primarily distributed from northeastern Australia through the South Pacific Islands and in India and southeastern Asia, including southern China and Malaysia, and from the Japanese Ryukyu Islands south to Taiwan. One species, *T. polystachya* (Sw.) Ames, is known to occur in the Neotropics, ranging from Florida south through the West Indies, from Central America, Venezuela, and the Galapagos Islands (Schuiteman & de Vogel, 2000; Su, 2000; Pridgeon et al., 2005; Chen et al., 2009). Plants of the genus share a combination of morphological features that include adventitious roots with nodules or tubers, stiff and erect stems, distinctly plicate leaves, one fertile anther with viscidia at the apex, and two staminodes, with the pollen grains aggregated within two pollinia (Su, 2000).

Three species of *Tropidia* were treated for the orchid flora of Taiwan (Su, 2000): *T. somae* Hayata, *T. curculigoides* Lindl., and *T. nipponica* Masam. Lin et al. (2006) described a new species, *T. nanhuae* W. M. Lin, L-L. K. Huang & T. P. Lin, from bamboo forest at 150 m, from Tainan County. *Tropidia nanhuae* is similar to *T. curculigoides* in the narrowly lanceolate or lanceolate to oblong leaf blades, but differs mainly in its dense racemose inflorescence. Yeh et al. (2009) described an additional species, *T. angustifolia* C. L. Yeh & C. S. Leou, from Pingtung County, collected from cloud forest at 600–800 m on Mt. Lilung. The authors noted that *T. angustifolia* resembles *T. nipponica*, but is distinguished by its linear to lanceolate leaves and larger, subsaccate corolla lips. Both *T. nanhuae* and *T. angustifolia* were described from southwestern Taiwan as endemic taxa.

In the spring of 2009, we made a field trip to the Namasia District in Kaohsiung City, southwestern Taiwan, and collected specimens of *Tropidia*. A remarkable feature of this collection was the subopposite, ovate to lanceolate leaves. After comparison with other species of the genus from Taiwan and elsewhere in Asia, we conclude that the plant from Namasia is indeed a new species, which brings the total of *Tropidia* species known from Taiwan to six.

KEY TO THE SPECIES OF *TROPIDIA* IN TAIWAN

1a. Leaves ovate to cordate or elliptic to ovate-oblong ... 2.
  2a. Height of plants less than 20 cm ..... *T. somae*
  2b. Height of plants greater than 20 cm ... *T. nipponica*
1b. Leaves narrowly lanceolate, lanceolate or ovate-lanceolate ..... 3.
  3a. Leaves more than 10 per stem ..... *T. curculigoides*
  3b. Leaves less than 6 per stem ..... 4.
    4a. Leaves mostly 2 per node, 3 to 5 per stem ..... *T. namasiae*
    4b. Leaves 1 per node ..... 5.
      5a. Height of plants exceeding 20 cm ..... *T. nanhuae*

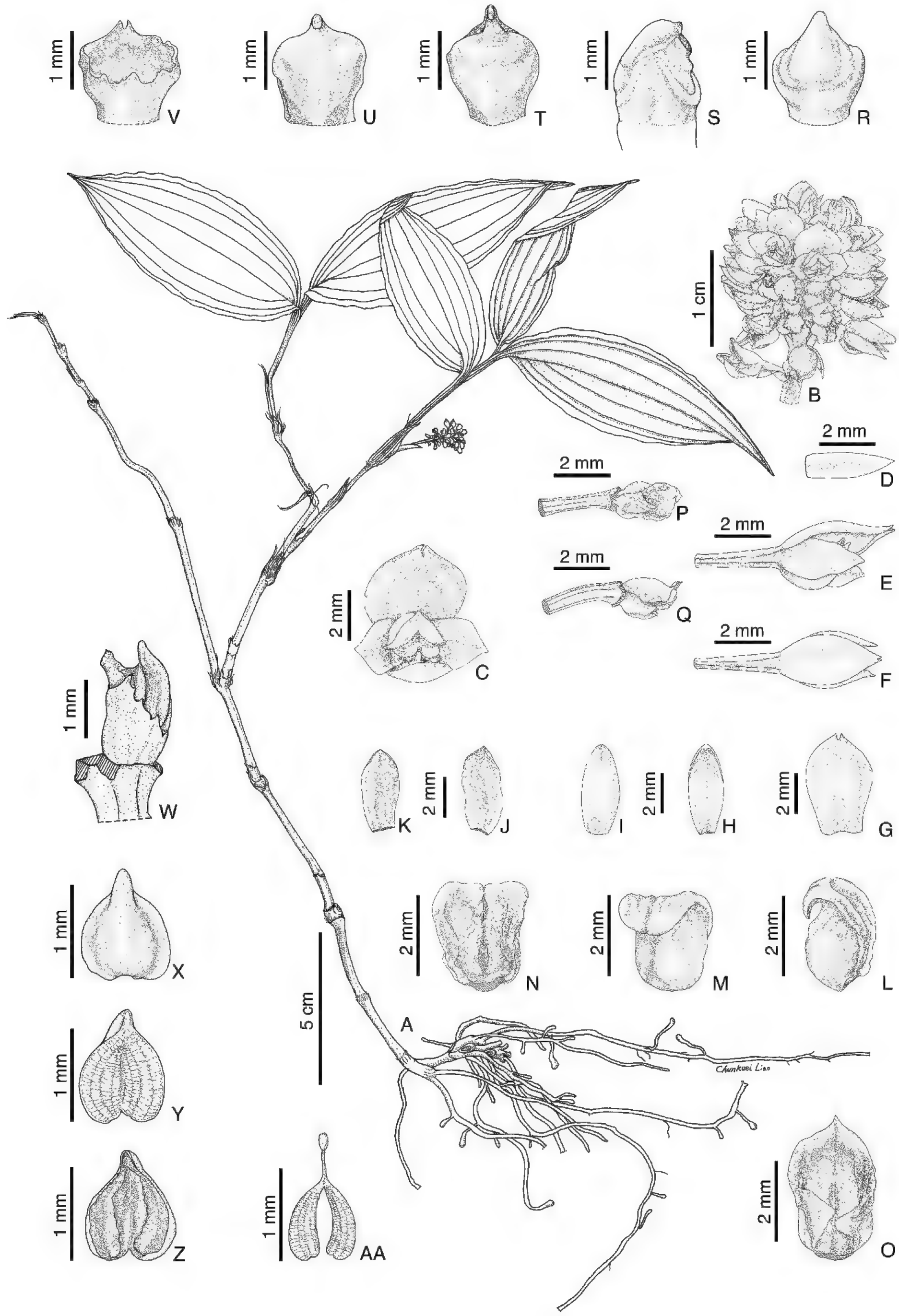

Figure 1. *Tropidia namasiae* C. K. Liao, C. P. Lin & M. S. Tang. —A. Fertile habit. —B. Densely congested raceme. —C. Individual flower, seen from above. —D. Bract. —E. Intact flower and column, with pedicel, lateral view. —F. Flower and column, with pedicel, ventral view. —G. Lateral sepals connate as synsepal, dorsal view. —H. Dorsal sepal, concave, as seen internally. —I. Dorsal sepal, external view. —J. Petal from flower right, internal view. —K. Petal from flower left, internal view. —L. Corolla lip, with folded apex, lateral view. —M. Lip, with folded apex, ventral view. —N. Lip, with folded apex, seen from above. —O. Lip, view from above, with the apical fold extended. —P. Column and lip of flower, dorsal view. —Q. Column and lip, lateral view. —R. Apex of column, dorsal view. —S. Apex of column, lateral view. —T. Apex of column, ventral view. —U. Column apex, with anther removed, ventral view. —V. Column apex, with anther removed, dorsal view. —W. Column in lateral view, note enfolded, bifid rostellum. —X. Anther, dorsal view. —Y. Anther, with the two pollinia evident, ventral view. —Z. Anther, with the pollinaria removed, ventral view. —AA. A single pollinarium. Drawn by C. K. Liao from the holotype, *C. K. Liao 3594* (TAI).

Table 1. The comparison of morphological characters and habitat between *Tropidia namasiae* and *T. angustifolia*.

Characters	*T. namasiae*	*T. angustifolia*
Stem height	40–60 cm	10–20 cm
Leaf shape	ovate to lanceolate	linear to lanceolate
Leaf size	7–10 × 3–4 cm	8–10.5 × 1.7–2.1 cm
Leaf base	obtuse or widely cuneate	cuneate
Leaf veins (lateral veins between veins)	7 (4 to 6)	5 (4 to 6)
Peduncle length	3.5–4 cm	4.5–5 cm
Flower number per raceme	20 to 35	9 to 12
Dorsal sepal shape and length	elliptic, 3.5–4 mm	obliquely oblong, 6.5–8 mm
Lateral sepal (connate as synsepal) shape	Obovate	oblong
Lateral sepal connate length and width	4.5–5 × 3–3.5 mm	8 × 3.8 mm
Petal length and width	4–4.5 × 2 mm	6.5–7 × 3 mm
Lip length and width	2.5–3 × 2–2.5 mm	5 × 3 mm
Column length	ca. 2 mm	3 mm
Anther length	ca. 1.5 mm	1.8 mm
Elevation	1380 m	600–800 m

5b. Height of plants less than 20 cm ..... *T. angustifolia*

Tropidia namasiae C. K. Liao, T. P. Lin & M. S. Tang, sp. nov. TYPE: Taiwan [Republic of China]. Kaohsiung City, Namasia Distr.: on mtn. ridge, 23°14′16.2″N, 120°43′41.5″E, 1380 m, 5 May 2009, *C. K. Liao 3594* (holotype, TAI). Figures 1, 2.

Haec species quoad sepala lateralia obovata fere connata, labium basiliter saccatum et columnam ad apicem rotundatam *Tropidiae angustifoliae* C. L. Yeh et C. S. Leou affinis, sed ab ea foliis ad quemque nodum plerumque duobus et racemo 20- ad 35-floro differt.

Herbs sympodial, terrestrial, perennial; rhizome short, ascending, with adventitious roots; roots tuber-bearing; stems erect, rigid, 40–60 cm tall, 3–4 mm diam., somewhat flattened; internodes 2–5 cm. Leaves subopposite, ovate to lanceolate, 7–10 × 3–4 cm, apex acute to acuminate, base obtuse or widely cuneate, margin wavy; veins 7, lateral veins 4 to 6 between veins; leaf sheaths ca. 2 cm. Racemes axillary, congested, bracteate, 3 × 2.5 cm; peduncle 3.5–4 cm; flowers 20 to 35, densely arranged, but not resupinate, glabrous, white, 11 × 11 mm; floral bracts lanceolate, glabrous, ca. 6 mm; pedicel and ovary ca. 7 mm. Flowers with the dorsal sepal free, elliptic, 3.5–4 × 2–2.5 mm, concave; lateral sepals ± connate, this synsepal cymbiform, obovate, bilobed at apex, 4.5–5 × 3–3.5 mm; petals free, similar to sepals, narrowly obovate, 4–4.5 × 2 mm, concave, keeled; lip yellow with orange at apex, the withered portion of lip red-brown at apex, but otherwise white, obovate, 2.5–3 × 2–2.5 mm, saccate at base, thickened and recurved at apex; disc with 2 longitudinal ridges; column straight, rounded at apex, including bifid rostellum ca. 2 mm; anther cordate, ca. 1.5 × 1 mm, margin revolute; pollinia 2, ca. 1.7 mm, sectile, granular; stipe and caudicle slender; viscidium ellipsoid; stigma elliptical. Fruit an ellipsoid capsule, longitudinally ridged, sparsely hirsute, 15–20 × 6–8 mm.

Distribution and ecology. *Tropidia namasiae* is endemic to Taiwan and is found only in the Namasia District, in Kaohsiung City. It is known from a single population of about 10 individuals from the under-story of a dense, evergreen, broad-leaved forest on a mountain ridge.

IUCN Red List category. *Tropidia namasiae* is assessed as Critically Endangered (CR B2a; D), according to IUCN Red List criteria (IUCN, 2001). This species has a very small and restricted population, because less than 10 individuals were in the population and only one population was found. The new species was not seen in this area from 2002 to 2004, based on the experience of vegetation research by first author (Chou et al. 2007), with the type collections made in 2009.

Phenology. *Tropidia namasiae* was observed in flower from May to June, with fruits observed from December to February.

Etymology. The specific epithet is derived from the location where the type specimen was collected.

Discussion. *Tropidia namasiae* is closely related to *T. angustifolia*. The morphological similarities of these two species are the shapes of lip and column and the length of leaves. They differ in their leaf shape, size and numbers per stem and the flower numbers per raceme. The comparison of morphological characters between the two species is given in Table 1.

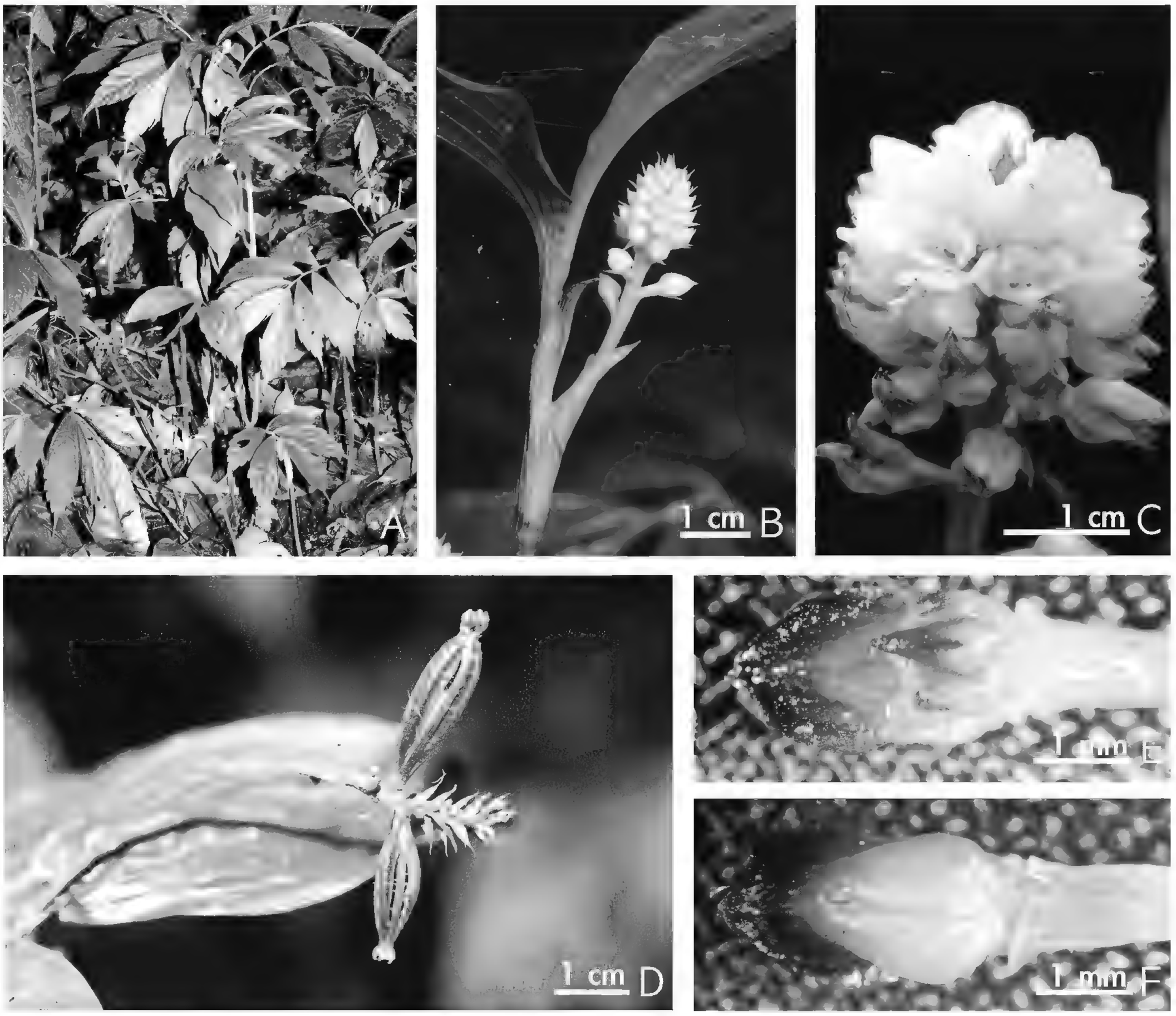

Figure 2. *Tropidia namasia* C. K. Liao, C. P. Lin & M. S. Tang. —A. Habitat at type locality. —B. Pre-anthesal inflorescence. —C. Inflorescence in full anthesis. —D. Post-anthesal inflorescence, with two capsular fruits visible. —E. Folded lip of corolla, with column and pedicel, dorsal view. —F. Folded lip with column and pedicel, ventral view.

Paratype. TAIWAN [Republic of China]. **Kaohsiung City, Namasia Distr.:** on mtn. ridge, 23°14′16.2″N, 120°43′41.5″E, 1380 m, 16 Feb. 2009, *T. P. Lin s.n.* (MO).

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Synthetodontium kunlunense (Mielichhoferiaceae, Musci), a New Moss Species from the Kunlun Mountain Range, China

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Abstract. A new moss species of the family Mielichhoferiaceae, *Synthetodontium kunlunense* J. C. Zhao & Y. Y. Liu, is described and illustrated. It was collected from soil substrates in an oasis in the Kunlun Mountains in Xinjiang Uyghur Autonomous Region in China. The peristome structure of this species is similar to that of *S. pringlei* Cardot, but *S. kunlunense* has longer leaves (0.5–1.3 mm vs. ca. 0.5 mm), shorter median leaf cells (8.6–21.7 μm vs. 40.6–72.6 μm), decurrent leaf bases (vs. not decurrent), a nodding capsule (vs. erect), and reddish proximal leaf cells (vs. green). *Synthetodontium* Cardot seems to be a disjunct genus distributed between East Asia and North America because the new species is known from a single locality in China, and another closely related species in the genus is known from four localities in Mexico.

Key words: China, IUCN Red List, Mielichhoferiaceae, *Synthetodontium*.

Traditionally, genera of the Mielichhoferiaceae were placed in the generalized moss family Bryaceae s.l. Some bryologists (e.g., Brotherus, 1924–1925; Chen et al., 1963) have treated Mielichhoferioideae as a subfamily in the Bryaceae. This taxonomic opinion prevailed until Cox and Hedderson (2003) concluded, based on molecular data, that these genera are more closely related to the Mniaceae than the Bryaceae. These two groups have many morphological differences (Chen et al., 1963). Molecular evidence from multiple loci suggests that the genera of Mielichhoferioideae may constitute early diverging lineages within the broader Mniaceae clade and that the group may therefore be paraphyletic (Shaw, 2009). Today most bryologists (e.g., Crosby et al., 1999; Hill et al., 2006; Shaw, 2009) regard the Mielichhoferiaceae and Mniaceae as separate families.

Five other genera—*Pohlia* Hedw., *Epipterygium* Lindb., *Pseudopohlia* R. S. Williams, *Synthetodontium* Cardot, and *Schizymenium* Harv.—in addition to the type *Mielichhoferia* Nees & Hornsch., have been accommodated successively into the Mielichhoferiaceae (Crosby et al., 1999; Hill et al., 2006; Shaw, 2009). *Synthetodontium* is distinguished from other genera of the family by having the endostome fused to the exostome teeth. *Synthetodontium* was originally described by Cardot (1909) based on specimens of *S. pringlei* Cardot from Mexico. Shaw and Crum (1982) included one other species in the genus, *S. costaricense* A. J. Shaw & H. A. Crum, but this species was later transferred to *Schizymenium* by Shaw (1985). *Synthetodontium*, as currently circumscribed, is monotypic and until now has been regarded as a genus endemic to Mexico.

Examination of specimens in the Bryaceae collected from the Kunlun Mountains, Xinjiang Uyghur Autonomous Region, China, revealed an unusual collection. At first sight we thought this moss could represent *Mielichhoferia*, based on its sporophytes borne on short lateral shoots and imbricate leaves. Further examination revealed, surprisingly, that this moss had peculiar capsules with a fused peristome, and this significant feature is known only for the genus *Synthetodontium*. Furthermore, this notable collection possessed other critical characters for the genus, such as the small plants, the crowded and appressed, ovate or ovate to lanceolate leaves, the laxly rhomboidal to long rhomboidal, median leaf

cells, the sporophytes appearing lateral, the pyriform capsules, long setae, and large spores, and so on (Crum, 1994). However, this collection clearly differed from the only known species in *Synthetodontium* in its leaf length, leaf base, median leaf cell size, color of the proximal leaf cells, and capsule orientation. We describe it here as a second, new species of the genus.

Synthetodontium kunlunense J. C. Zhao & Y. Y. Liu, sp. nov. TYPE: China. Xinjiang Uyghur Autonomous Region: Kunlun Mtns., Yecheng Co., Guosasi Village, 37°22′04″N, 76°44′27″E, 3400 m, 23 July 2009, *S. Mamtimin 09336* (holotype, HBNU; isotype, MO). Figures 1–3.

Haec species *Synthetodontio pringlei* Cardot affinis, sed ab eo foliis longioribus ad basem decurrentibus, foliorum cellulis proximalibus rubellis rubicundisve, cellulis medianis brevioribus atque capsula nutante differt.

Plants dioicous, dark green, in a flat mass, 2–3 mm tall; rhizoids produced from the bud base and from degenerated caulonema; stems erect, branched, with central strand in cross section; 1 to 3 layers of small, pigmented, thick-walled cells surrounding gradually larger, hyaline, thin-walled cells. Leaves crowded and appressed when dry, imbricate when moist, concave, ovate or ovate to lanceolate, 0.5–1.3 × 0.4–0.6 mm, broadly acute or obtuse, ± decurrent at base; margins plane to recurved almost throughout the entire length; costa single, ending at or near the apex, rarely short excurrent, ca. 65 μm wide at base, smooth; distal leaf cells laxly long rhomboidal to rhomboidal, 10.8–26.8 × 7.2–9.3 μm, median leaf cells almost rhomboidal, 8.6–21.7 × 6.3–9.1 μm, occurring in rows oblique to the costa, somewhat narrower in 2 or 3 rows toward the margins but not forming a distinct border; proximal leaf cells quadrate to rectangular, always reddish, 14.7–34.7 × 7.5–13.3 μm. Perigonia budlike, terminal but appearing to be lateral because of well-developed innovations; perichaetia at the ends of short, inconspicuous stems, sometimes appearing lateral because of innovations; setae orange-yellow, slender, 7–14 mm. Capsules nodding and symmetric, 2–3 mm, pyriform, with a narrow neck about 1/3 the capsule length, light brown; operculum hemispheric to convex to conic, blunt; annulus present, consisting of two rows of cells; peristome teeth inserted below the mouth, brown and very finely cross-striolate below, pale yellow to hyaline and smooth above, endostomial membrane and segments tightly adherent to the exostome, rather smooth, endostome shorter than the teeth. Spores 25–30 μm, very finely papillose, spores germinating on the 7th day on 2% agarose culture medium in Petri dishes; protonemal system with chloronema and caulonema. Gametophore buds on chloronema or caulonema cells; sporeling *Bryum*–type (Nishida, 1978).

Distribution, habitat, and ecology. As currently known, *Synthetodontium kunlunense* is restricted to soil substrates at 3400 m in an oasis within the Kunlun Mountain range. The population occurs in a grass patch on soil in partial shade within shrubby vegetation dominated by *Ajania tibetica* (Hook. f. & Thomson ex. C. B. Clarke) Tzvelev, *Iljinia regelii* (Bunge) Korovin, *Nitraria sphaerocarpa* Maxim., and *Sympegma regelii* Bunge. Associated bryophytes include *Brachythecium salebrosum* (Hoffm. ex. F. Weber & D. Mohr) Schimp., *Bryum algovicum* Sendtn. ex Müll. Hal., *B. recurvulum* Mitt., *Distichium capillaceum* (Hedw.) Bruch & Schimp., *Gymnostomum aurantiacum* (Mitt.) A. Jaeger, *Hondaella brachytheciella* (Broth. & Paris) Ando, *Isopterygium pulchellum* (Hedw.) A. Jaeger, *Orthodicranum montanum* (Hedw.) Loeske, *Rhizomnium striatulum* (Mitt.) T. J. Kop., *Tortula mucronifolia* Schwägr., and *T. yuennanensis* P. C. Chen. Similar areas in the Kunlun Mountain Range should be surveyed for *Synthetodontium kunlunense*.

With the addition of this second species, *Synthetodontium* becomes a disjunctly distributed genus with *S. pringlei* known from four locations in Mexico (GBIF Data Portal, 2010) and *S. kunlunense* from a single site in China. With a similar disjunct distribution of the moss genus *Ptychomitrium* Fürnr. (Cao & Vitt, 1994), *Synthetodontium* provides more evidence for the close phytogeographic relationship between East Asia and North America. Schofield and Crum (1972) suggested that some bryophytes may appear to be disjunctly distributed merely because collections have been inadequately collected in the intervening areas. The odds of the establishment and survival of new colonies are very remote because diaspores (e.g., spores) are transported randomly and because most bryophytes are ecologically restricted and thrive in a narrow range of conditions that favor germination and survival of the propagula (Crum, 1972). The comprehensive influence of many factors, such as climate and physical and geographical conditions, between the two remote locations may have led to infrageneric differentiation (Wu et al., 2001).

IUCN Red List category. According to the criteria of International Union for Conservation of Nature and Natural Resources (IUCN, 2001) for

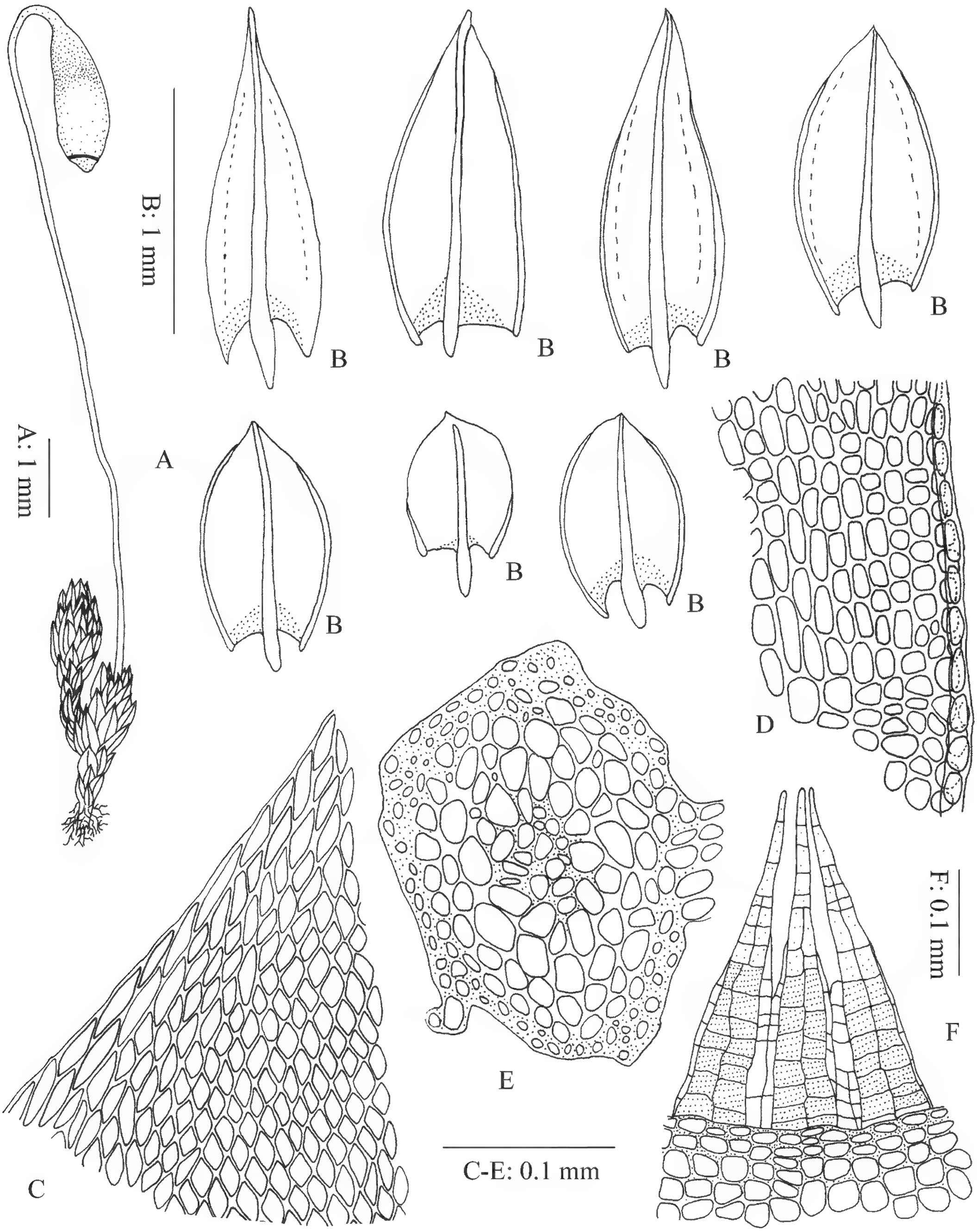

Figure 1. *Synthetodontium kulunense* J. C. Zhao & Y. Y. Liu. —A. General habit and aspect of a gametophore with sporophyte. —B. Seven leaves. —C. Distal leaf cells. —D. Proximal leaf cells. —E. Stem cross section. —F. Peristome. A–F drawn from the holotype *S. Mamtimin 09336* (HBNU).

assessing categories of conservation status, *Synthetodontium kunlunense* should be considered Vulnerable (VU D1+2) owing to its population size estimate at less than 1000 mature individuals and existence at only a single known location. Agricultural activities and tourist activities would destroy the original habitats of the new species and other mosses since the type locality, Guosasi Village, is a tourist destination. The species is further threatened by global warming.

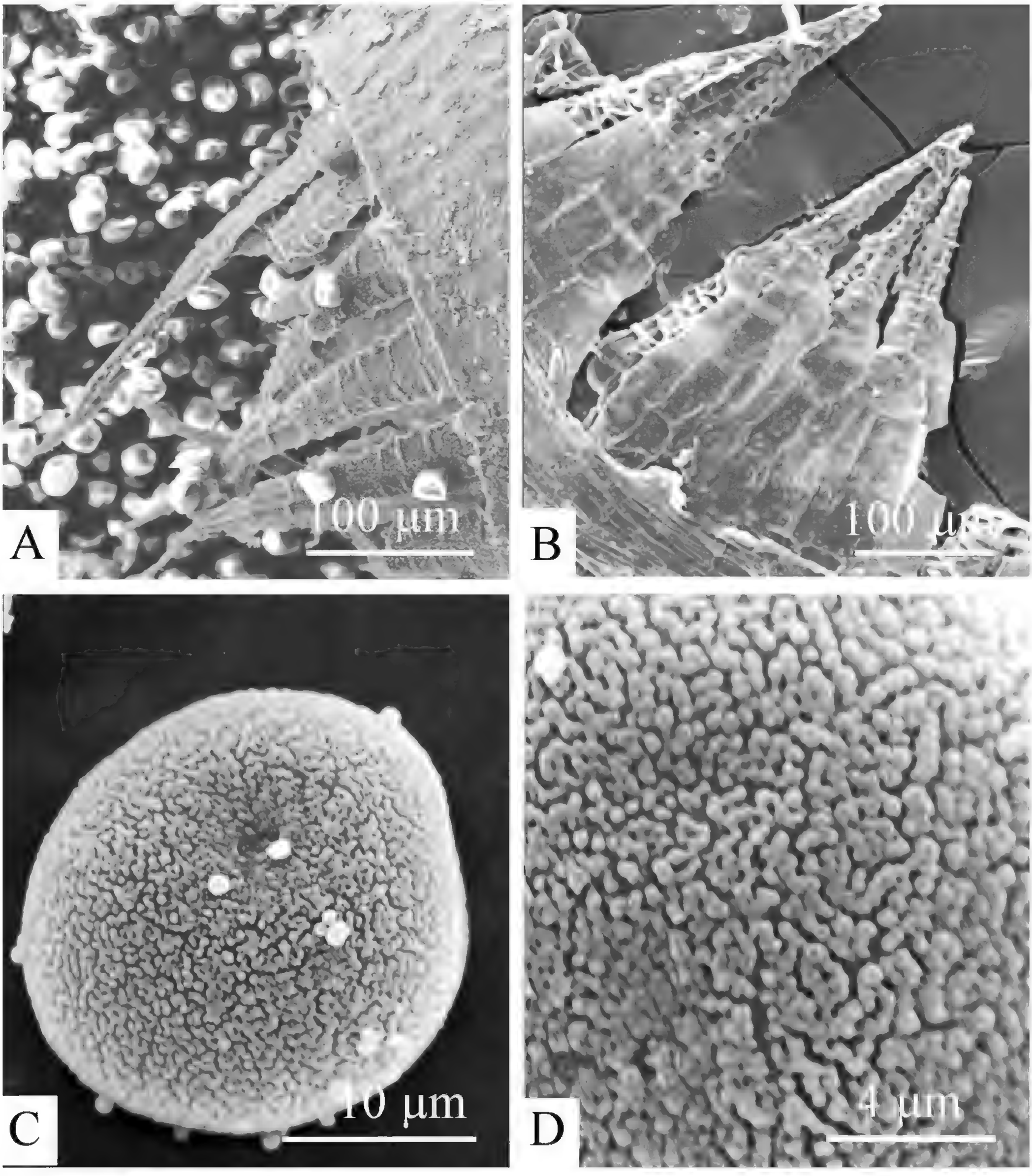

Figure 2. Scanning electron micrographs of *Synthetodontium kulunense* J. C. Zhao & Y. Y. Liu. —A. Outer surface of peristome. —B. Inner surface of peristome. —C. Spore. —D. Exine ornamentation of spore. Taken from the holotype *S. Mamtimin 09336* (HBNU).

Etymology. The species epithet refers to the type locality on the Kunlun Mountains in the Xinjiang Uyghur Autonomous Region in China.

Discussion. Superficially the endostome segments of *Synthetodontium kunlunense* appear to be positioned opposite the exostome teeth, as in the Funariales and Encalyptales. Further observations using scanning electron microscopy reveal two or three vertical lines on the ventral endostomial surface. Shaw (1984) explains the endostomial structure of *S. pringlei*, noting that there are two or three columns of cells on the inner surface of the endostome. These give rise to the cilia that are fused to each other as well as to the exostome teeth. Thus, the endostome is not clearly organized into segments and cilia. This appearance can lead to a misunderstanding of the peristome pattern, but this is in fact a moss with segments that alternate with the exostome

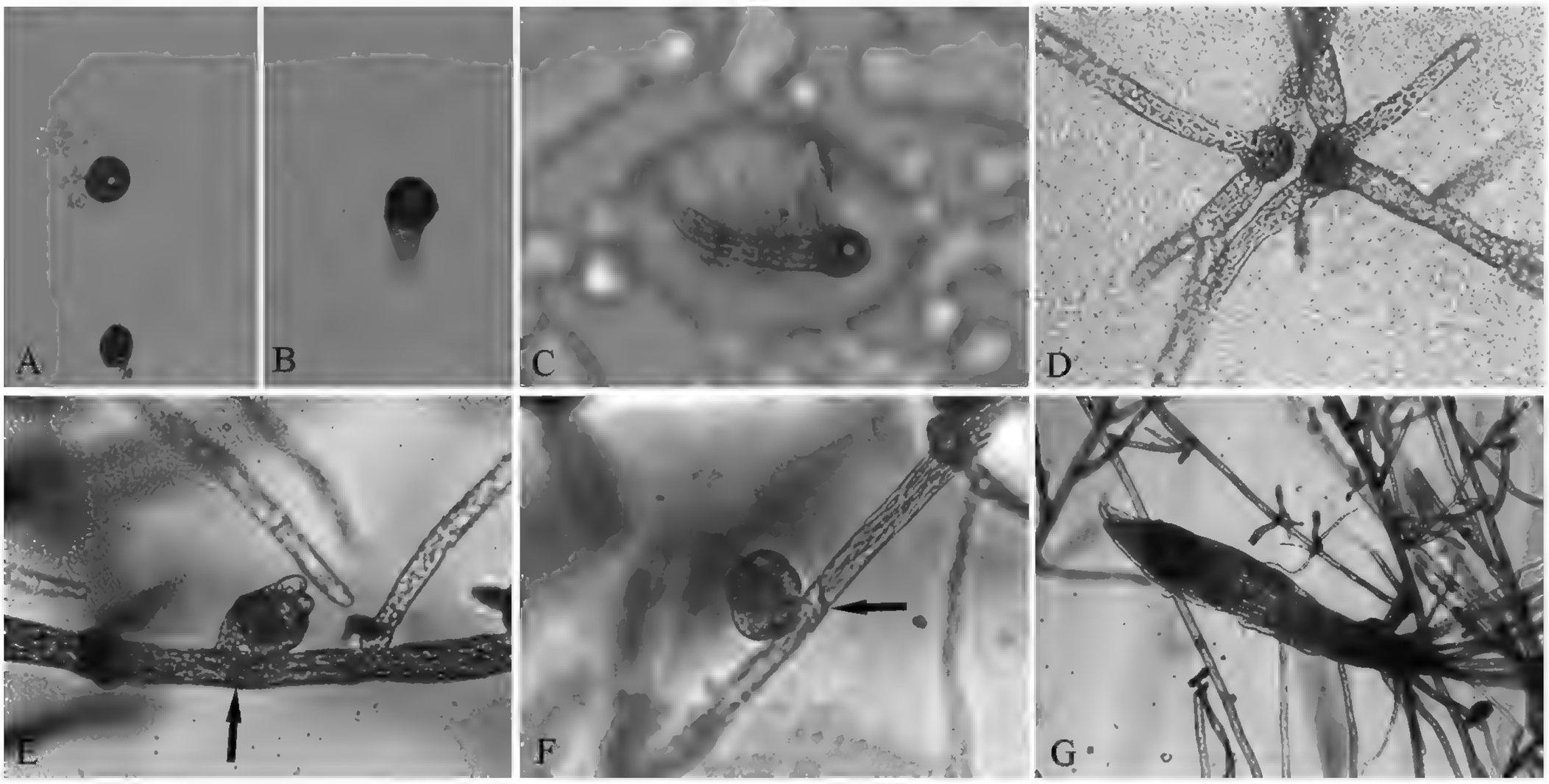

Figure 3. Spore germination and protonema development of *Synthetodontium kulunense* J. C. Zhao & Y. Y. Liu. —A. Spore. —B. Germinating spore. —C. Spore with bipolar germination. —D. Spore with polypolar germination. —E. Bud (arrow) on the chloronema. —F. Bud (arrow) on the caulonema. —G. Young gametophyte. Micrographs of material taken from the holotype *S. Mamtimin 09336* (HBNU).

teeth. This structure is also one of the most important features used in identifying *Synthetodontium* (Shaw & Rooks, 1994; Shaw, 2000). Based on the morphological features of *S. kunlunense* and current conceptions of the family (Shaw, 2009), the new species surely belongs to the Mielichhoferiaceae.

Synthetodontium kunlunense differs from *S. pringlei*, the only other species in the genus, in several morphological characters. The new species has longer leaves (0.5–1.3 mm vs. ca. 0.5 mm in *S. pringlei*), shorter median leaf cells (8.6–21.7 μm vs. 40.6–72.6 μm), decurrent leaf bases (vs. not decurrent), a nodding capsule (vs. erect), and reddish proximal leaf cells (vs. green). Furthermore, the two taxa are geographically isolated and disjunct between continental masses. *Synthetodontium pringlei* is restricted to North America (Mexico) (GBIF Data Portal, 2010); *S. kunlunense* is thus far found only in the Kunlun Mountains of China.

The gametophyte of *Synthetodontium kunlunense* is similar to that of *Mielichhoferia*, especially *M. sinensis* Dixon. However, there are morphological differences between the two species. *Synthetodontium kunlunense* is defined by its double peristome, in which the endostomial membrane and segments tightly adhere to the exostome, whereas *M. sinensis* has a single exostomial peristome (Li, 2006; Zhang et al., 2007). Distal and medial leaf cells of *S. kunlunense* are shorter than those of *M. sinensis* (77–125 × 10–20 μm), and the proximal leaf cells are always reddish rather than green.

Bryum algovicum is similar to *Synthetodontium kunlunense* in that the endostome is fused to the exostome teeth (Shaw, 1984; Li, 2006; Zhang et al., 2007). The cilia stand alone, and segments are perforate in *B. algovicum*, while the cilia of *S. kunlunense* are fused to each other and adhere to the segments on one side or the other. The true segments in *S. kunlunense* are narrow and nonperforate, appearing to lie opposite the exostome teeth. In addition, *B. algovicum* can generally be distinguished from *S. kunlunense* by its taller plants, 5 mm (Crum & Anderson, 1981) to 10 mm (Noguchi, 1988; Li, 2006; Zhang et al., 2007), the larger leaves 2–3 mm, the long-excurrent costa, and the leaf border composed of two to four rows of linear, thick-walled cells. *Synthetodontium kunlunense* are observed as shorter plants, 2–3 mm, with smaller leaves, 0.5–1.3 × 0.4–0.6 mm, the costa usually ending at or near the apex, and the marginal cells somewhat narrower, with the two or three rows not forming a distinct border.

Synthetodontium kunlunense may be closely related to *Haplodontium* Hampe or *Plagiobryoides* J. R. Spence [*Bryum* Hedw. subsect. Areodictyon (Müll. Hal.) Broth.], as indicated by its similar leaves and laminal areolation. However, *Haplodontium* consists of species with an extremely reduced peristome, typically of one layer (Spence, 2005). Those of *Plagiobryoides* have leaf margins showing a strongly differentiated border, the capsules zygomorphic with an oblique mouth, and a double-layered peristome. These features distinguish *Haplodontium* and *Pla-*

giobryoides (Spence, 2005). These phylogenetic relationships will be more clearly elucidated from future molecular sequence analysis as more material is collected.

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Two New Species of *Passiflora* supersect. *Decaloba* (Passifloraceae) from Eastern Mexico

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Abstract. Two new species of *Passiflora* L. (Passifloraceae) endemic to eastern Mexico are described and illustrated and placed in subgenus *Decaloba* (DC.) Rchb., supersection *Decaloba* in a clade distinguished by no laminar nectaries. *Passiflora dictamo* DC. is a synonym of *P. biflora* Lam., and the rare diminutive species previously assigned to *P. dictamo* in Killip's monograph is described as *P. lauana* J. M. MacDougal. A second species, *P. complanata* J. M. MacDougal, is described and placed in the *P. sexflora* Juss. species group, where it is notable for its clusters of large flowers to 4 cm diam., flattened stems, and unusual 1/2 phyllotaxy. From Mexico we now recognize 75 native species of passionflowers.

Keywords: IUCN Red List, Mexico, *Passiflora* subg. *Decaloba*, Passifloraceae.

Presented here are two new species of passionflowers from the states of Oaxaca and Puebla, Mexico, bringing the number of native species of *Passiflora* L. known in that country to 75, of which 59 are in subgenus *Decaloba* (DC.) Rchb. This subgenus is comprised mostly of smaller-flowered species with small purple berries, and it contains a number of clades and species groups that have radiated and diversified in the seasonal temperate or wet mountains of Mexico. Many of the species in subgenus *Decaloba* have limited distributional ranges, sometimes confined to one part of a mountain range, and the two new species described herein are local endemics.

The first species to be described below was originally treated by Killip in his monograph (1938) under the misapplied name *Passiflora dictamo* DC. Killip (1938: 144) assigned that name to two Mexican specimens collected by C. A. Purpus "with much hesitation, for that [name] may be only a synonym of *P. biflora* [Lam.]." De Candolle had coined the name *P. dictamo* in 1828 (p. 324) for one of the "fl. mex. ic. ined.," or one of the unpublished plates from the Royal Botanical Expedition to New Spain, 1787–1803, sometimes referred to as the Sessé and Mociño Expedition. Reported as DC. Plate no. 28, a colored copy (McVaugh, 1980), the plate conserved at G-DC is actually an original painting and bears the Fl. Mex. Icones number 362 in Mociño's hand, according to McVaugh (1980: 131). A virtually identical, but slightly more detailed, original painting is in the Torner collection at the Hunt Institute for Botanical Documentation, Torner coll. no. 0363, labeled as "Passiflora Normalis" and "362." The DC. Plate no. 28 at G-DC was designated as lectotype of the name *P. dictamo* by McVaugh (2000: 427). Although only one painting is the lectotype, it is useful to consider evidence from both in this analysis because they are nearly identical copies, contemporarily or nearly simultaneously executed (McVaugh, 1980), and the one at the Hunt Institute is slightly more detailed. The two paintings show a fruiting passiflora with bilobed leaves with obtuse to rounded, divergent tapering lobes, and no laminar nectaries. The fruits depicted show extended androgynophores, approaching the length of the peduncles. The lack of leaf glands is unusual in bilobed passionflowers and was noted by both de Candolle and Killip.

At MA and F there are specimens from the expedition labeled "Passiflora normalis [L.]," *Sessé & Mociño 3302* (F, fragm. seen; MA, photo seen), with a range of leaf shapes strikingly similar to the range of leaf shapes shown in the paintings described above. This specimen is identified and corresponds to *Passiflora biflora* Lam. The specimen shows small inconspicuous leaf glands typical of that species, but it is remarkable that the range of leaf shapes, especially the angle of the lateral veins with most lobes widely divergent but with some more narrow lobes, matches closely the same range seen in the paintings, and the leaves closely resemble those in the paintings. The specimen has no fruits, but the relatively long androgynophores seen in the paintings are typical of *P. biflora*. It appears, then, that the inconspicuous leaf glands were overlooked by the original artist, and that the name *P. dictamo* and its derivative *Cieca dictamo* (DC.) M. Roem. (1846: 2: 146) are later synonyms of *P. biflora*.

Passiflora biflora Lam., Encycl. 3(1): 36. 1789, non *Passiflora biflora* Dombey ex Triana & Planch.,

Ann. Sci. Nat., Bot., sér. 5, 17: 156. 1873, nom. inval. *Decaloba biflora* (Lam.) M. Roem., Fam. Nat. Syn. Monogr. 2: 161. 1846. TYPE: "L'Amérique méridionale [country unknown] cult." s.d., *s. coll.*, *s.n.* (P-LAM [barcode] P00307580).

Passiflora dictamo DC., Prodr. 3: 324. 1828, syn. nov. *Cieca dictamo* (DC.) M. Roem., Fam. Nat. Syn. Monogr. 2: 146. 1846. TYPE: Mexico (lectotype, designated by McVaugh [2000: 427], as DC. Plate 28, Sessé & Mociño Expedition [Fl. Mex. Icones 362], G-DC, G-DC photo at F-030459).

The range of leaf shapes of the *Purpus s.n.* specimens placed by Killip (1938: 144) under the misapplied name *Passiflora dictamo* does not closely resemble the shapes in the painting that stands as lectotype for *P. dictamo*. Additionally, that lectotype painting remarkably resembles the collection *Sessé & Mociño 3302* at MA, which is now identified as *P. biflora*. The Purpus specimens cannot be assigned to any other known species in *Passiflora*; therefore, they are described here under a new name.

1. Passiflora lauana J. M. MacDougal, sp. nov. TYPE: MEXICO. Puebla: [Mpio. de Caltepec,] Cerro de Mazize [18°11′54″N, 97°25′29″W], 8000 ft., on rocks, July 1907, *C. A. Purpus s.n.* (holotype, UC-140971, F photo, MO image, NY photo, US photo). Figures 1, 2.

Haec species sarmentosa exigua a congeneris *Passiflorae* sectionis *Decalobarum* (DC.) Rchb. foliis bilobis nectariis laminaribus carentibus, bractea nulla vel solitaria dentataque, flore in diam. minus quam 1.5 cm, corona biseriata, androgynophoro ca. 4 mm longo atque ovario glabro distinguitur.

Small perennial herbaceous climber; stems 0.7–1.5 mm diam. at reproductive nodes, strongly pubescent with minute antrorsely curved trichomes less than 0.2 mm, somewhat terete, longitudinally grooved-striate, the ridges rounded, very obvious when dried; stipules (1.5–)2–3.5 × (0.3–)0.4–0.6(–0.8) mm, linear-lanceolate to lanceolate, falcate, 3- or 4-veined, margins entire or sometimes serrulate or with a tooth, glabrous except sometimes some trichomes on margins, often purple at base, late-necrescent distally. Leaves with petioles 4–8 mm, eglandular, adaxially pubescent, abaxially glabrous; laminas 0.5–2.0 × 1.4–3.7 cm, depressed obovate in outline, entire, variegated on lower leaves with pale stripes along main veins, especially lateral veins, lightly pubescent to nearly glabrous adaxially, with at least a few trichomes on main veins, abaxially glabrous, shallowly bilobed 0.1–0.4 the distance to shallowly cordate to truncate or rarely rounded base, the lateral lobes 0.9–2.6 cm, obtuse to rounded, sometimes truncate, very rarely subacute, the central lobe 0.5–1.2 cm, obsolescent, truncate, retuse, or rarely widely obtuse (often absent, with the result that the length of the central vein is the same as the width of the lateral lobes), the angle between the lateral lobes 72°–125°; laminar nectaries absent; prophylls of vegetative bud two, 0.7–1 mm, ovate, 3-toothed, apically short-caudate. Peduncles (1)2 per node, 0.6–2 cm, uniflorous; bracts absent or 1 at apex or to 7 mm below the apex, 0.8–1.3 × 0.3–0.6 mm, narrowly oblong, irregularly few-toothed at apex or near apex, often appearing ca. 3-toothed. Flowers ca. 1.2 cm diam., green-white or pale green-yellow with purple ring in center, the corona mostly pale yellow; stipe 1.5–2.5 mm; hypanthium (floral tube) ca. 5 mm diam., tinged purple, glabrous; sepals ca. 6–7 × 3–3.5 mm, ca. narrowly ovate-oblong, 3-nerved, with no projection, pale green-yellow adaxially, green-yellow and tinged with purple, especially on the nerves, abaxially, sometimes flushing completely purple-red after anthesis; petals ca. 3.5–5 × 1.5–2 mm, narrowly ovate-oblong, whitish or pale green-yellow; coronal filaments in 2 series, the outer filaments 3.5–4 mm, long-clavate, apically blunt, yellow-green at the narrowed base and sometimes adaxially flushed with purple, the distal half falcate-spreading and pale to light yellow, the inner series 1–2 mm, capillary, clavate-capitellate; operculum ca. 1 mm high, membranous, plicate, purple; limen floor pale green; androgynophore 3.8–4.2 mm; ovary ca. 2 × 1.8 mm, subglobose to widely ellipsoid, glabrous. Mature fruit not seen, immature fruit from photograph an ellipsoid berry, green, 8 × 6 mm, apparently indehiscent (*Lau s.n.*, MO).

Remarkable for the small size of its leaves and flowers, reduced number of bracts, and lack of laminar nectaries, *Passiflora lauana* is known only from two collections by Purpus in Puebla made about a century ago, and from a set of three color photographs taken in Oaxaca (descending into Santiago Nuyoo [17°01′N, 97°45′W, ca. 7000–8000 ft.] from the east, Sep.) in 1987 by Alfred B. Lau and deposited at MO. Lau's photographs are not accompanied by a voucher specimen, yet there is no doubt that they represent a plant conspecific with the specimens. The small leaves are the same shape, very depressed obovate, bilobed, with the diagnostic absence of laminar nectary glands; the rather broad stipules match; and the details of the flowers coincide perfectly. Though separated by ca. 140 km, the habitat and elevation of the two localities are extremely similar. The photographs by Lau at MO (excerpted in Fig. 2) have provided details on the color of the parts of the flower, as well as the orientation of the corona and the immature fruit.

Figure 1. Image of holotype (UC) of *Passiflora lauana* J. M. MacDougal.

Passiflora lauana clearly belongs in subgenus and supersection *Decaloba* on account of the eglandular petioles, bilobed leaf, and plicate operculum. The absence of laminar extrafloral nectaries is a synapomorphy of a recently recognized large clade in supersection *Decaloba* (Krosnick et al., 2013), and the new species is assigned there. This clade includes series *Luteae* (Small) J. M. MacDougal, section *Xerogona* (Raf.) Killip, the *P. sexflora* Juss. group (MacDougal, 1989), and the *P. bilobata* Juss.

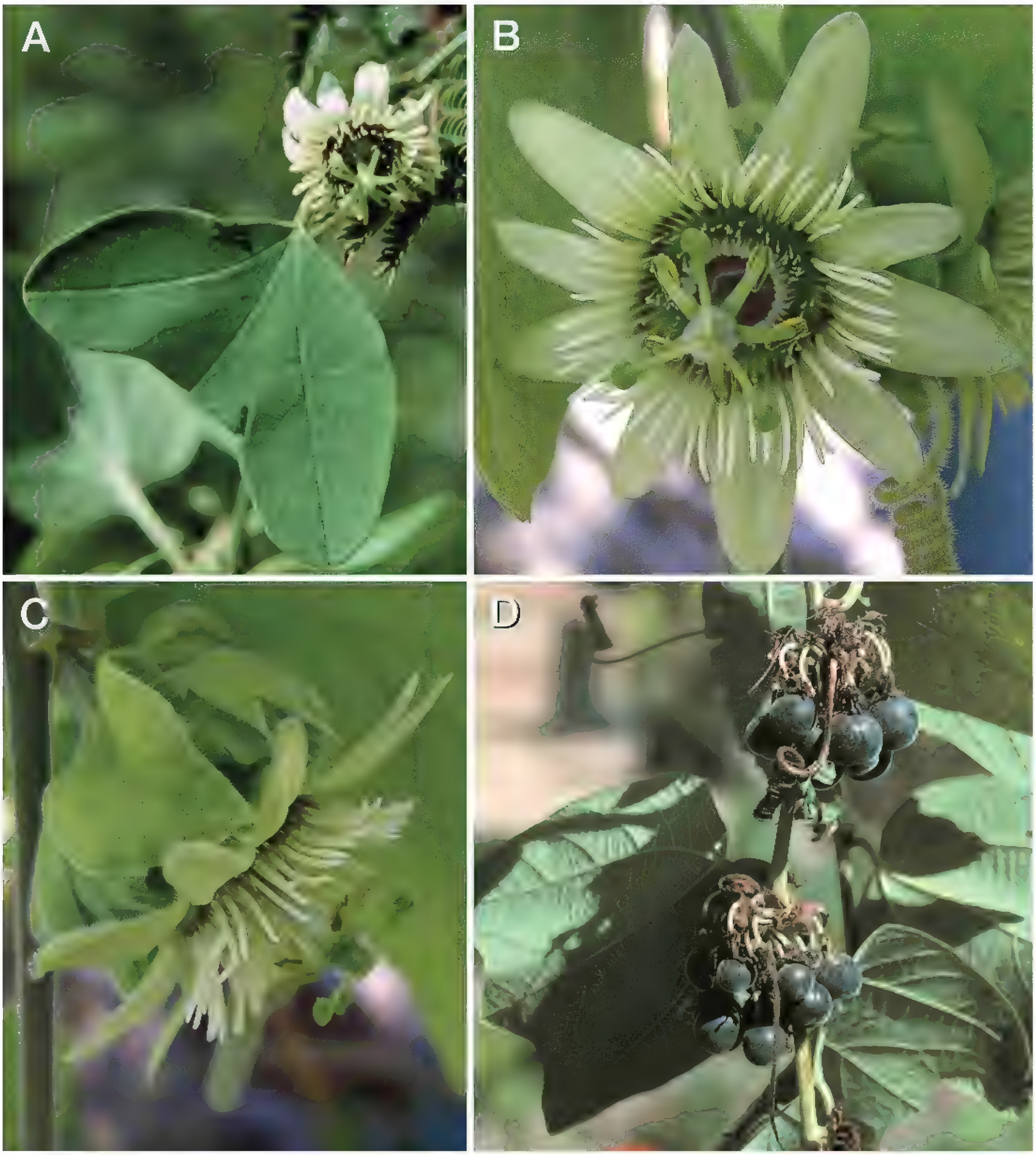

Figure 2. *Passiflora lauana* J. M. MacDougal (A) and *P. complanata* J. M. MacDougal (B–D). —A. *Passiflora lauana*. Flower and leaf, taken near Santiago Nuyoo, Oaxaca; photograph by Alfred Lau (MO). —B. *Passiflora complanata*. Flower at anthesis, taken from the paratype *J. M. MacDougal 555GR*, in cultivation in California, U.S.A.; photograph by Jorge Ochoa. —C. *Passiflora complanata*. First flower of developing inflorescence to open, on primary axis of peduncle; note conspicuous bracts, taken from *J. M. MacDougal 555GR*, in cultivation; photograph by Jorge Ochoa. —D. *Passiflora complanata*. Fruiting branch in field, San Mateo Yetla, taken from the paratype *J. M. MacDougal & J. Miley 555*.

group (Killip, 1938). These groups have their centers of diversity in southeastern Mexico, except the *P. bilobata* group, which is West Indian. *Passiflora lauana* is most similar to the species in series *Luteae* and the *P. bilobata* group by its small pale green-yellow flower with purple flush, small and rather deeply bilobed leaves without acute lobes, inconspicuous pubescence, and small indehiscent berry. The reduced number of bracts (or their absence) is reminiscent of series *Luteae*, while the slightly thickened and falcate distal portion of the outer coronal filaments resembles the *P. bilobata* group.

Limited sampling of the holotype revealed two prophylls at the vegetative ramifying bud, but this should be confirmed. Two is unusual in *Passiflora* sect. *Decaloba*, but is seen in at least one species of

series *Luteae*, *P. sanctae-mariae* J. M. MacDougal (MacDougal, 1995).

Killip (1938) first described the dried *Purpus s.n.* specimens, and his evaluation is accurate except that there are definitely two coronal rows, not one as he wrote. The inner row is reduced in number, is capillary, and appears to vary in expression among the different samples. Also, Killip mentions two bracts on the peduncles, a "single setaceous, deciduous bract at the point of articulation and a minute, 3-toothed bract near the middle" (1938: 143). The holotype has absolutely no bracts or bract scars on the several peduncles there, and those on the paratype *Purpus 3546* are solitary, with no additional bract scars seen. Perhaps the species has two bracts rarely. Killip (1938: 144) also mentions "fruit ca. 1 cm in diam.," but I found no fruits, fruit remnants, or seeds on the specimens. Observations of the fruit herein are taken from one of Lau's photographs.

The type locality in Puebla, Mexico, is close to San Luis Tultilanapa, according to Sousa (1969). This area is in southernmost Puebla, near the border with the state of Oaxaca, an area with a pronounced dry season. Passifloras also collected in this area by Purpus include *Passiflora suberosa* L. and *P. bryonioides* Kunth. I found notation of the elevation of 8000 feet jotted on a loose field label inside the packet of the holotype; it does not appear on the label.

Etymology. The species is named for Brother Alfred Bernhard Lau (1928–2007), indefatigable explorer, plant collector, and Christian missionary. Born in Germany, he moved to the United States and then Mexico after World War II, where he founded an orphanage in Veracruz. Known better for his botanical and field expertise in Cactaceae, Lau also discovered many rare and undescribed species of Passifloraceae and introduced several of the Mexican species to horticulture. His field notes and photographs have been instrumental to the understanding of many passionflowers, and he has been an inspiration to the author.

Phenology. *Passiflora lauana* is known in bud and flower from July to September, with immature fruit in September.

IUCN Red List category. According to IUCN Red List criteria, *Passiflora lauana* is categorized as Vulnerable (VU). This species can plausibly be assigned to the range of categories EN to NT (Endangered to Near Threatened); however, the best estimate is VU. The species is known only from two locations that are 140 km apart. The extent of occurrence (EOO) criteria suggest Endangered status, with an EOO < 5000 km^2, fewer than five locations (criterion B1a), and probable continuing decline in the area of occupancy (AOO) inferred from rate of habitat loss attributable to conversion of land to agriculture and grazing in that part of Mexico (criterion B1b(i,ii)). However, the specific habitat appears to be scrubby or rocky areas, and the species, a small inconspicuous vine, has not been carefully searched for, with the likelihood of extinction in the next 20 years assessed as low.

Paratype. MEXICO. **Puebla:** vic. of San Luis Tultilanapa, near Oaxaca, July 1908, *C. A. Purpus 3546* (UC-140977, B photo [barcode] 10 0293107, F photo).

2. Passiflora complanata J. M. MacDougal, sp. nov. TYPE: MEXICO. Oaxaca: 1 mi. NE of Villa Hermosa on Hwy. 175 & 46 mi. S of Tuxtepec, along Gulf slope, cloud forest of tree ferns, 4750 ft., 15 Aug. 1975 (bud, fl.), *D. G. LeDoux, K. J. Torke & Ellis 2308* (holotype, MO-2472151; isotypes, ASU, CAS-592525, ENCB, G-170542, INIF, LL, MEXU-262348). Figures 3, 4.

Haec species sarmentosa *Passiflorae sexflorae* Juss. et *P. rugosissimae* Killip affinis, sed ab eis flore 3–4.5 cm diam., bracteis 6–17 × 2.5–12 mm non profunde fissis atque caule semper complanato distinguitur.

Tough herbaceous vine to 3–6 m, densely white, short-pubescent or hispidulous throughout with trichomes 0.15–0.5(–0.6) mm, up to 1.2 mm long on buds; stems flattened, narrowly elliptic in cross section, (2.5–)4–6 mm wide in primary growth, stem phyllotaxy 1/2, cernuous at vigorous growing tips, otherwise weakly or not cernuous at apices, fruiting branches often pendent; stipules 3–4.2 × 0.5–1.7 mm, linear triangular to narrowly triangular, abruptly widened at base. Leaves with the petioles 0.9–2(–3) cm; laminas 6–16.5 × 7–18 cm, truncate-widely elliptic in outline, or often truncate to very widely obovate, entire, not variegated, hispidulous on both surfaces with trichomes 0.1–0.4 mm, shallowly 2- or (sub)3-lobed 0.1–0.2(–0.4) the distance to cordate base, the lateral lobes obtuse to acute, always longer than the central lobe, the central lobe obtuse, obsolete, or rarely acute, often with a 3 mm mucro, the sinus between lobes lunate, subtruncate, or shallowly 3-lobed with a cusp in the center, the angle between the lateral lobes (30°–)37°–60°; lowermost leaves and juveniles deeply 2-lobed up to 0.65 the distance to the laminar base, the lobes lanceolate, acute; laminar nectaries absent; tendrils curved during development at shoot tip, up to 35 cm long at maturity; prophyll of vegetative bud one, 1.8–

4 mm, narrowly triangular to narrowly lanceolate. Peduncles 2 per node (rarely 1 per node on lowermost nodes or on young plants), usually richly branched to 3 or 4 orders (rarely unbranched or branched only 1 order at lowermost nodes or on young plants), (1- to) 7- to 20-flowered, 0.5–1.2(–1.4) cm to the first branch, other branches typically 0.3–1 cm, pedicels 0.6–2 cm; bracts (6–)8–17 × (2.5–)5–12 mm, widely elliptic or ovate to obovate, concave, the apex usually acute and abruptly long-cauduate with a 3–5 mm apiculus, margins entire or more usually irregularly shallowly few-cleft or long-toothed, especially near apex, light green, bract position anomalous by exaggerated displacement of each bract distally. Flowers 3–4 cm diam. (to 4.5 cm pressed), green-white or pale green-yellow, often with dull purple centrally, the corona nearly white to cream, the odor mild, fresh, greenish, slightly sweet, with a hint of honey; stipe 0.5–2 mm; hypanthium (floral tube) 9–10 mm diam.; sepals 14–23 × 6.5–10 mm, narrowly ovate-triangular with no projection, light green-yellow abaxially, nearly white to pale green-yellow adaxially; petals 11–18 × 4–6 mm, narrowly ovate or narrowly ovate-oblong, nearly white to green-white to very pale green-yellow; coronal filaments in 2 series, the outer 8–12 mm, ca. 0.6–0.7 mm diam. (fresh), filiform, slightly curved-falcate in distal third, short-attenuate at very apex, cream and unmarked or cream with dull violet or purple on the basal 2 mm, the inner 3–4.5 mm, capillary, apically subclavate, erect; operculum 2–3.5 mm, membranous, plicate, unmarked or with a hint of purple-red; limen edge long-papillate, the floor usually dull or pale purple-red; androgynophore 8–9.5 mm, nearly white except pale purple-red ca. 2 mm at very base, the free staminal filaments 4.5–5 mm, light green, the anthers 3–3.5 mm, the pollen yellow; ovary 2–3 × 1.5–2.9 mm, widely ellipsoid to subglobose, densely white-hirsute, ca. 102 to 138 ovules per flower ($N = 3$), styles 6–7.5 mm, including stigmas. Fruit 13–20 mm diam., subglobose (oblate to widely ellipsoid), estipitate, blue-black, glaucous, lightly pubescent; arils clear-gelatinous, sweet, very fruity, with taste like Concord grape; seeds 2.4–2.9 × 1.4–1.6 mm, black, transversely sulcate with 6 or 7 sulci, the intervening ridges slightly verrucose, the chalazal beak inclined toward the raphe. Germination epigeal.

Passiflora complanata typically has very short petioles and leaves that are broad, thick, and shallowly 2-lobed. The leaves resemble those of the only distantly related *P. costaricensis* Killip. The whole plant is densely white, short-pubescent, the stem is flattened, and the flowers are clustered at the nodes into sometimes massive balls of light green bracts, buds, and pale green-yellow or nearly white flowers. There can be 20 to 40 flowers clustered at a node, though only one to five of the ca. 4 cm flowers will open each day at any one node (greenhouse observations). *Passiflora complanata* is assigned to subgenus *Decaloba* supersect. *Decaloba* (DC.) Rchb. on the basis of its cernuous shoot tip, eglandular petioles, bilobed leaf, plicate operculum, purple berry, transversely sulcate seeds, and lack of chloroplast intron *rpoC1* (Hansen et al., 2006: 149). It has no laminar extrafloral nectaries, which is a synapomorphy of a recently recognized unnamed large clade in supersection *Decaloba* (Krosnick et al., 2013), and the new species is assigned there. Morphological characters of the leaf shape, lack of variegation, broad floral bracts, branched peduncles, and very small seeds place the new species in the *P. sexflora* group (MacDougal, 1989). This placement was confirmed on the basis of four genes by Krosnick et al. (2013) who used this new species in their analysis and placed it in the *P. sexflora* alliance as sister to *P. rugosissima* Killip.

In the *Passiflora sexflora* alliance, *P. complanata* most resembles *P. manantlanensis* J. M. MacDougal in its leaf, the Chiapas form of *P. rugosissima* in its floral bracts and stem, and *P. porphyretica* Mast. in the size of its flower. *Passiflora manantlanensis*, from the mountains of southwestern Mexico, is very similar overall, especially because the range of lobe angles of the leaves is the same, but its leaves are usually more deeply bilobed with acute apices, the bracts are very deeply 5- to 9-cleft, and the smaller flowers have an androgynophore of only 4.5–7 mm. The closely related *P. rugosissima* of Guatemala to Hidalgo, Mexico, is also similar to *P. complanata* in its thick leaves, several-branched inflorescences, wide bracts, and somewhat flattened stems. *Passiflora rugosissima* grows at higher elevations (1700–2600 m), however, and has much smaller flowers with an androgynophore of only 3.8–5 mm; the lobe angle of the leaves is wider; the length of the peduncle to the first branch is (1.0–)1.4–4.0 cm; and the floral bracts are usually smaller and often deeply lacerate. *Passiflora rugosissima* sometimes has a similar flattened stem, as discussed below.

The large size of the flower of the new species, with an androgynophore of 8–9.5 mm, is approached in this species group only by *Passiflora porphyretica*, which can have flowers almost as large, with an androgynophore length of 4.8–8 mm. That species also has large concave bracts, but they are uncleft and sometimes colored brown or olive and are usually glossy-glandular. It can immediately be distinguished from the new species by its unbranched peduncles,

more obviously 3-lobed leaves, and a habitat of seasonally dry areas.

The flattened ribbon-like stem is a distinctive and unusual characteristic of *Passiflora complanata*, and from this the specific epithet is derived. A complanate stem is very unusual in the genus *Passiflora* and is associated here with a phyllotaxy of 1/2 (Ulmer & MacDougal, 2004), which is very obvious at the distichous shoot tip. Nevertheless, the vasculature in this species appears to present helical sympodia of a 2/5 arrangement, more so the norm for the family (Masters, 1871; MacDougal, 1994). The phyllotactic fraction determined from the gross external superposition of the leaves does not correspond to the fraction obtained from the vasculature, as reported for several other species of passionflowers (MacDougal, 1994). The stem is uniformly complanate in the specimens of the new species and obviously complanate in many of the sheets of *P. rugosissima*. Some sheets of *P. rugosissima*, however, have stems that appear to be rounded and subangulate when dried. I cannot state definitely that the flattened stem is characteristic of that species or that it is a synapomorphy shared between these two species, although it appears probable. Study of more living material is needed.

The position of the bracts is unusual in that they are displaced onto the branches they would normally subtend, a topology termed "recaulescent" by Cusset (1968) who analyzed this in various species of Passifloraceae. The bracts here, however, are even more extreme: they are sometimes displaced past the next branching point. This appears to be the situation in all the species of this species group that have compound peduncles (MacDougal, pers. obs.).

A cleared leaf of *Passiflora complanata* from *MacDougal 555GR* was studied and illustrated by Klucking (1992: 243, pl. 95, fig. 2). In fresh greenhouse material of three ovaries, I found 35 to 46 ovules per placenta in rows about four ovules wide. As expected in this supersection of *Passiflora*, the chloroplast intron *rpoC1* is absent in this species (*MacDougal 555GR*, Hansen et al., 2006). The species was self-incompatible in the greenhouse, and no fruits were produced by autogamy over many years of cultivation (MacDougal, pers. obs.; Jorge Ochoa, pers. comm.).

This species was introduced to horticulture in 1980 through the cultivation of several individuals of *MacDougal 555GR* from field-collected seeds. Its axillary clusters of relatively large sweet-smelling flowers and broad pubescent bilobed leaves caught the interest of hobbyists, and this one introduction is still cultivated in Europe and the United States today. The name has already appeared as a nomen nudum in a number of popular books and newsletters and websites. A color photograph appeared in Klock (1996: 115).

Distribution and ecology. *Passiflora complanata* is a species of wet premontane to lower montane forest, cloud forest, and bosque mesófilo de montaña in a small area on the Caribbean drainage of the Sierra Madre Oriental of Oaxaca, Mexico, at (180–) 600–1600(–1800) m. Tree ferns are very commonly recorded as associates, as well as *Cavendishia* Lindl. (Ericaceae) and *Costus* L. (Costaceae). Although of very limited distribution, the new species is locally abundant according to several of the labels. Herbivores are unknown except for a yellow and black larva of the moth *Josia* Hübner sp. (Notodontidae: Dioptinae) taken on *MacDougal 555* (MO-spirit). Native pollinators are unknown, but the floral syndrome suggests medium-sized bees; honeybees have been photographed at the flowers and may effect pollination (J. Ruffin, pers. comm.). The Chinantec vernacular name for this plant is huan-kañ as recorded on *Schultes 565*.

Phenology. *Passiflora complanata* is known to flower from late May to November and fruit from July to December.

IUCN Red List category. According to IUCN Red List criteria, *Passiflora complanata* is categorized as Least Concern (LC). Although the EOO is < 5000 km^2, and there is projected continuing decline in the AOO caused by habitat loss from conversion to agriculture, the populations are not severely fragmented, are known presently from at least 20 populations, are sometimes documented as locally abundant with little exploration of areas away from roads, and the probability of extinction in the next 100 years is low.

Paratypes. MEXICO. **Oaxaca:** Distr. Ixtlán, carr. Valle Nacional a Ixtlán al NO de Chiltepec, *R. Cedillo & D. Lorence 439* (CAS, NY); Distr. Tuxtepec, Mpio. San Felipe Usila, alrededores de Cerro Verde, 8 km linea recta al NNE de San Felipe Usila, *G. Ibarra M., J. Meave, C. Vargas & M. Vargas 3708* (MO); Distr. Ixtlán, Mpio. de Santiago Comaltepec, La Esperanza, *R. López L. 316* (MEXU, MO); Distr. Ixtlán, Mpio. de Santiago Comaltepec, R. Acahual Grande, *R. López L. & Martin 679* (MEXU, MO); carr. Valle Nac. a Ixtlán al NO de Chiltepec, *D. Lorence 439* (NY); Distr. Tuxtepec, Mpio. de Valle Nac., San Mateo Yetla, *J. MacDougal & J. Miley 555* (CAS, CHAPA, DUKE, ENCB, F, GH, MEXU, MICH, MO, NY, TEX, US, XAL), thereafter cultivated from seeds of *555* at Duke University 1980–1983, pressed Oct. 1982–July 1983, *J. MacDougal 555GR* (BH, BM, DUKE, GOET, MEXU, MICH, MO, MO-spirit, UPCB, US, XAL); entre Puerto Eligio a Comaltepec, Km. 149 entre Tuxtepec a Oaxaca, Sierra Juaréz, *G. Martínez C. 542* (CAS, CHAPA, ENCB, MEXU, MO, NY, WIS); Distr.

Ixtlán, Mpio. Santiago Comaltepec, 2.5 km de Metates sobre carr. Tuxtepec–Oaxaca, *L. Mendizábal 213* (MEXU); Distr. Tuxtepec, Mpio. San Felipe Usila, cuenca del Río Perfume, ladera O, 1.5 km en linea recta al NE de Santa Cruz Tepetotutla, *P. Osorio H. 247* (MO); mtn. betw. Choapam & San Juan Teotalcingo, near summit, *R. E. Schultes 565* (UC, US); 0.8 mi. N of Vista Hermosa & 18.1 mi. S of Valle Nac. along Hwy. 175, *J. F. Utley & K. Utley 6733* (DUKE); 2 km al S de Metates, Carr. Tuxtepec–Oaxaca, *J. A. Vázquez 4900* (MO, WIS); Sierra Madre Oriental, 1.5–2 mi. N of Vista Hermosa, *G. L. Webster, G. J. Breckon & S. P. Lynch 17464* (HUA, MEXU).

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Two New Species of *Dracaena* (Asparagaceae, Nolinoideae) from Central Africa, with a Note on the Identity of *D. braunii*

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Abstract. Two new species of *Dracaena* Vand. ex L. (Asparagaceae, Nolinoideae) from Central Africa are here described and illustrated. *Dracaena longipetiolata* Mwachala & Eb. Fisch. from Gabon is distinguished from *D. phrynioides* Hook. by its long petioles and elliptic leaves. *Dracaena litoralis* Mwachala & Eb. Fisch. is described from Cameroon and also occurs in Equatorial Guinea, Gabon, and Congo-Brazzaville. This new taxon differs from *D. braunii* Engl. by its smaller flowers whose perianth lobes are shorter than the tube. The identity of *D. braunii* is discussed and its affinity with *D. litoralis* analyzed.

Key words: Asparagaceae, Central Africa, Cameroon, Congo-Brazzaville, *Dracaena*, Equatorial Guinea, Gabon, IUCN Red List.

Dracaena Vand. ex L. belongs to the family Asparagaceae, subfamily Nolinoideae, according to the APG III classification (Stevens, 2008; APG III, 2009; Chase et al., 2009). This subfamily is represented in Central and East Africa by three genera, namely *Dracaena*, *Eriospermum* Jacq. ex Willd., and *Sansevieria* Thunb. (APG III, 2009). While preparing a revision of *Dracaena* for Flora of Tropical East Africa, several unidentified specimens came to light that represent new species, two of which have already been described (Mwachala et al., 2007; Mwachala & Cheek, 2012). Two further new taxa are described in the present paper.

Dracaena longipetiolata Mwachala & Eb. Fisch. sp. nov. TYPE: Gabon. Crystal Mtns., 12 km SW of chutes de Kinguele [Kinguele Falls], 18 Feb. 1966, *N. Hallé & J. F. Villiers 5362* (holotype, P). Figure 1.

Dracaenae phrynioidi Hook. affinis, sed ab ea petiolo exalato plus quam 20 cm longo et longitudinem laminae ellipticae duplo excedente valde differt.

Herb with subterranean rhizome; plants to 35 cm tall, petioles 37–85 cm, 2–3 mm wide, wingless. Leaf lamina elliptic, widest at middle, rounded at the base, acuminate at the apex, 25–30 × 8.5–10 cm, main parallel veins visible on adaxial surface, reticulate venation with secondary venation anastomosing between main parallel veins prominent on abaxial surface, midrib conspicuous abaxially, ending before leaf apex, discolorous, dark green on adaxial surface and rusty brown on abaxial surface. Rachis of inflorescence to 35 cm, 1.5–2 mm diam.; inflorescence paniculate, appearing spikelike, fruits on lateral glomerules (condensed lateral partial inflorescences), each glomerule with ca. 5 pedicels; pedicels not exceeding 1 mm. Flowers not known. Fruit an ellipsoid, 3-lobed berry, 15 × 8 mm.

Distribution and habitat. *Dracaena longipetiolata* is known only from the type collection from the Crystal Mountains in Gabon. The new species was found in riverine vegetation, in submontane rainforest.

IUCN Red List category. *Dracaena longipetiolata* is assessed as DD or Data Deficient, according to IUCN (2001) criteria. More exploration in the Crystal Mountains is required to establish the range and habitat requirements for this species.

Discussion. This new taxon clearly belongs to the *Dracaena aubryana* Brongn. ex E. Morren group of Mwachala (2005), based on its herbaceous habit usually not exceeding 1 m in height and its possession of a distinct petiole that is at least half as long as the lamina. It differs from *D. phrynioides* Hook. by its greatly reduced stems and the wingless petioles. These are between 37 and 85 cm in length, and over twice as long as the leaf lamina, which is elliptic. While also having very short stems, *D. phrynioides* has a leaf lamina much shorter and not exceeding 25 cm, about equaling the petiole, and is ovate-lanceolate in shape.

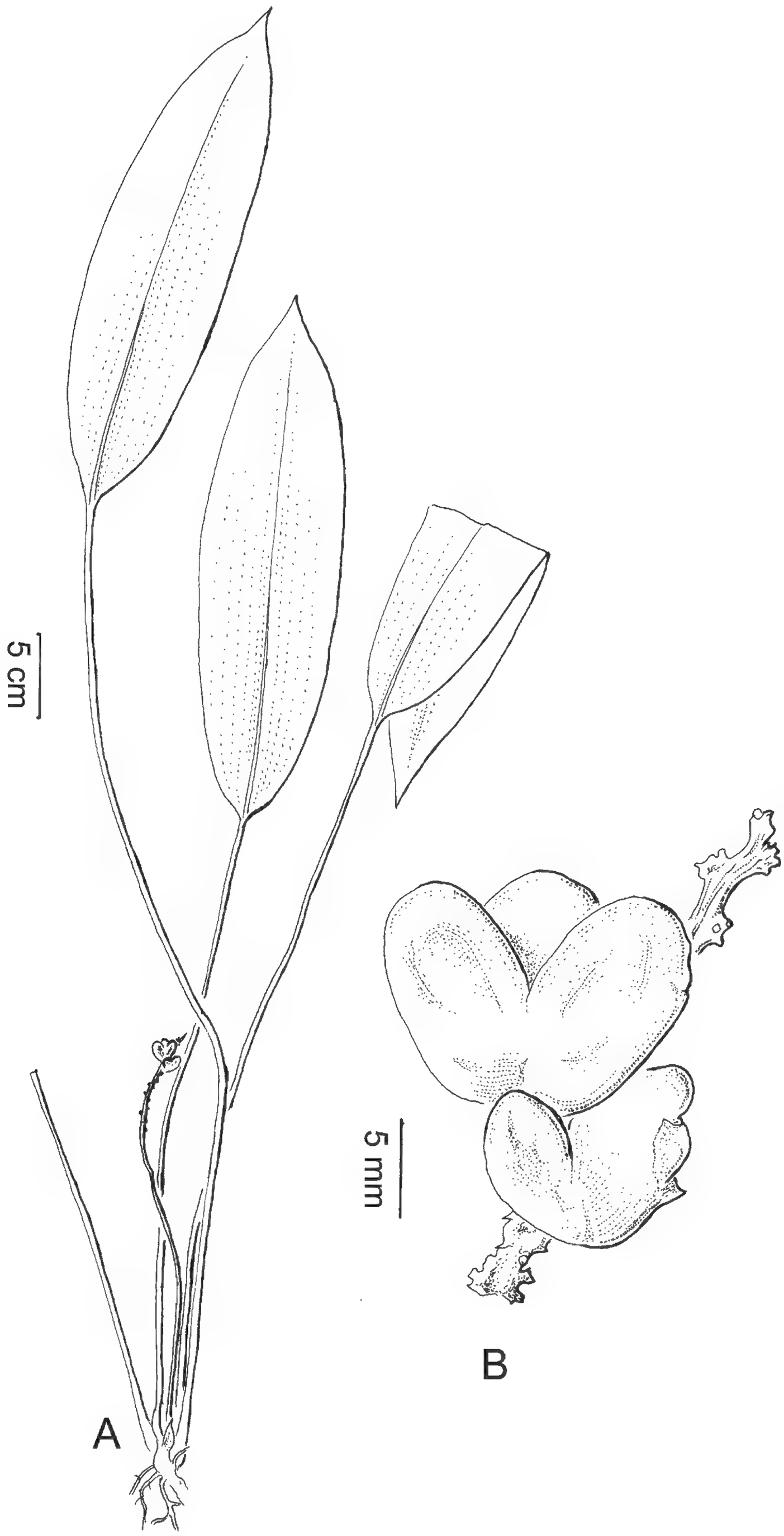

Figure 1. *Draceana longipetiolata* Mwachala & Eb. Fisch. —A. Fertile habit. —B. Part of infructescence. Drawn from the holotype, *N. Hallé & J. F. Villiers 5362* (P).

Despite the fact that flowers are presently unknown and the specimens bear only mature fruits, we describe this new species as it shows very distinctive features and can be easily recognized.

Dracaena braunii Engl. in Baker and Engl., Bot. Jahrb. Syst. 15: 479, taf. XX (20). 1893 [1892]. TYPE: Cameroon: "Kamerun, Malimba," 1889, *J. Braun 329* (holotype, B). Figure 2.

Baker and Engler (1893: 479) described *Dracaena braunii* based on a plant from Malimba, Cameroon. The protologue stated that the plant was imported by J. Braun and cultivated in the Botanical Garden of Berlin, where it subsequently flowered in August 1891. The type for this species (*J. Braun 329*), comprising a single flowering shoot and a reproduction of the plate published in the protologue, is still at Berlin. The specimen matches the apex of the flowering stem depicted in Baker and Engler (1893) and was probably prepared from the same plant. When Engler's type and protologue were checked against material determined as *D. braunii* in BR, K, LBV, P, and WAG, the morphologies did not match. The most important differences were the leaf shape, leaf arrangement, and flower size. No material was found in any of these herbaria that matched *Braun 329* or Engler's protologue and illustration of *D. braunii*. The examined specimens thus represent a new species, *D. litoralis*, which is described here for the first time. A systematic search should be conducted in the coastal areas of Cameroon and Gabon to relocate *D. braunii*, which is at present known only from the type and the plate accompanying the protologue. *Draceana braunii* is distinguished from *D. litoralis* by its phyllotaxy, with its leaves being spaced along the stem, unlike the basal rosette in *D. litoralis*. Its petioles are 2–3 cm long, much shorter than the 8–14 cm long petioles in *D. litoralis*. The leaf lamina in *D. braunii* is up to 6 cm long, whereas it ranges from 8 to 12 cm in *D. litoralis*. The flowers of *D. braunii* are longer than those of *D. litoralis*, being about 2.3 cm long, compared to a maximum of 1.5 cm long in *D. litoralis*. Furthermore, the perianth lobes of *D. braunii* are longer than the tube, whereas these are shorter than the tube in D. litoralis.

Dracaena litoralis Mwachala & Eb. Fisch. sp. nov. TYPE: Cameroon. Kribi District: betw. Kribi & Lonji, 19 Mar. 1968, *P. Mezili 90* (holotype, P). Figure 3.

Dracaenae braunii Engl. affinis, sed ab ea foliis rosulatis, petiolo valde longiore, lamina foliari longiore, floribus brevioribus et lobis perianthii brevioribus quam tubo differt.

Herb to 30 cm high, single-stemmed; stem to 1.5 mm diam.; rhizome and roots orange. Leaves clustered near the base of the shoot; blades narrowly elliptic to broadly lanceolate, 8–12 × 2.5–3 cm, base cuneate, apex acuminate; petiole 8–14 cm, with an amplexicaule base forming a sheath to 3 cm long. Inflorescence terminal, erect, spicate, 6 cm; peduncle 19 cm; flowers in clusters of 1 to 3; bracts triangular, to 2 mm; pedicels 2 mm, articulate above the middle. Flowers pale white tinged with purple, perianth lobes 4–5 × 0.6–0.8 mm, perianth tube 7–8 mm long. Stamen filaments white, anthers creamy. Fruits globose, 1–1.2 × 0.6–1 cm, 1- to 3-seeded; seeds bony globose in single-seeded fruits, (sub)hemispheric in 2- or 3-seeded ones, 0.8–1 cm diam.

Distribution and habitat. *Dracaena litoralis* was collected in coastal regions of Cameroon, Equatorial Guinea, Gabon, and the Republic of Congo. The taxon has been found in undergrowth in deep shade at edge of coastal forests, comprised of mangroves, to 2–5 m height.

IUCN Red List category. *Dracaena litoralis* is assessed as Vulnerable or VU B1ab(iii), according to IUCN (2001). It is known from the beaches of South Cameroon, Equatorial Guinea, Gabon, and the Republic of Congo, which are prime development sites for plantations, petroleum, and tourism.

Discussion. *Dracaena litoralis* is closely related to *D. braunii* from which it differs in the phyllotaxy. Its leaves are arranged in a rosette at the base of the stem, while those of *D. braunii* are evenly spaced out along the stem. The petioles are longer in the new species (8–14 cm vs. 2–3 cm in *D. braunii*), and the leaf lamina is longer (8–12 cm vs. less than 6 cm). The flowers are shorter (to 1.5 cm long vs. 2.3 cm), with the perianth lobes shorter than the tube, 4–5 mm and 7–8 mm, respectively, versus the perianth more subequal, with the lobes 1.3 cm and the tube ca. 1 cm in *D. braunii*.

Paratypes. CAMEROON. **Kribi:** betw. Kribi & Lonji, 19 Mar. 1968, *P. Mezili 90* (P); 23 km on rd. from Kribi to Campo, 6 Dec. 1974, *J. J. F. E. De Wilde 7819* (BR, P); 22 km Sud de Kribi, 3 Jan. 1983, *A. P. M. van der Zon 1972* (P); 10 km env. de Kribi, 19 Feb. 1965, *Letouzey 13494* (P); ca. 8 km N of Kribi, 8 Aug. 1964, *W. J. J. O. de Wilde & B. E. E. de Wilde-Duyfjes 2907* (P); chutes de Lobé, 6 Jan. 1968, *Bamps 1708* (BR); near Rocher du Loup, 17 Mar. 1978, *Lowe 3614* (K). EQUATORIAL GUINEA. **Bata:** alrededores de Akonikieng, bosque secundario, 7 Feb. 1992, *Carvalho 5011* (BR). GABON. **Port Gentil:** 1 July 1966, *A. Le Thomas 10* (P); SE of Port Gentil, 16 Sep. 1968, *F. J. Breteler & R. A. van Raalte 556* (BR); betw. Mayumba & Nyanga, Mar. 1903, *H. Pobéguin s.n.* (P); **Mayumba:** 23 Jan. 1907, *G. Le Testu 970* (BR); Mayumba peninsula, ± 15 km S of Mayumba town, 18 Nov. 1983, *J. J. F. E. De Wilde et al. 654* (K, P); behind Okala, 18 Feb. 1993, *Dibata 1111* (BR); **Estuaire:** peninsula of Cap Esterias, 8 Dec. 2003, *C. C. H. Jongkind & R. Niangadouma 5895* (LBV); **Pointe Denis:** Pongara, Ovingombé, 20 Dec. 1999, *E. L. A. N. Simons & R. Westerduijn 501* (LBV); **Littoral:** Bois de Singes, 29 Mar. 1986; *H. de Foresta 869* (P); Kouilou, PCA de Nzambi, entre N'tietie et le Carrefour du Gabon, 30 Jan. 1974, *P. Sita 3621* (P).

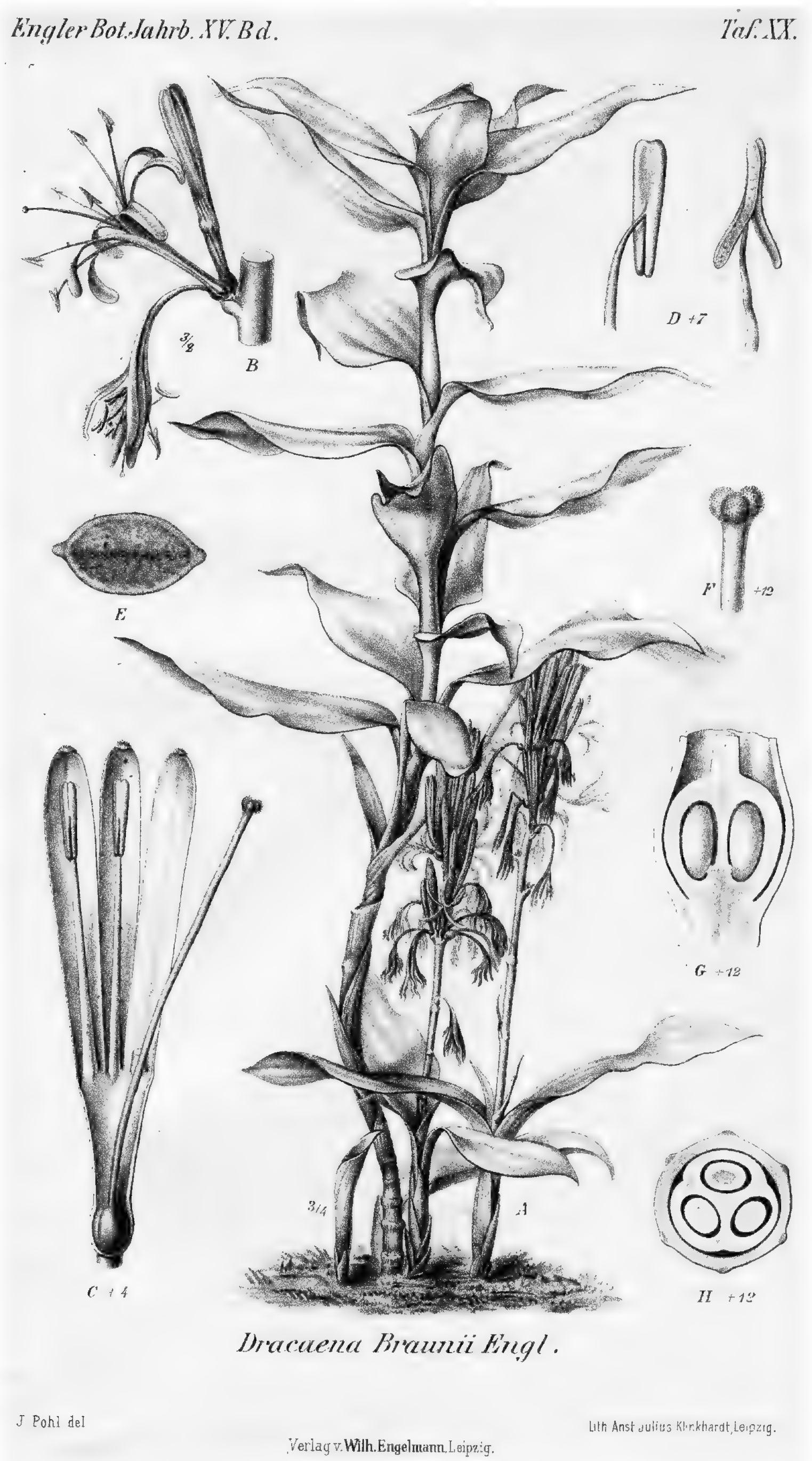

Figure 2. *Dracaena braunii* Engl. Plate detail clockwise from bottom: habit, showing vegetative and fertile shoots; flower laid open; seed; portion of inflorescence; stamens; style and stigma; ovary in longitudinal section; ovary in cross-section. Plate 20 from Engler 1893: 479. Drawing from *J. Braun 329* (B).

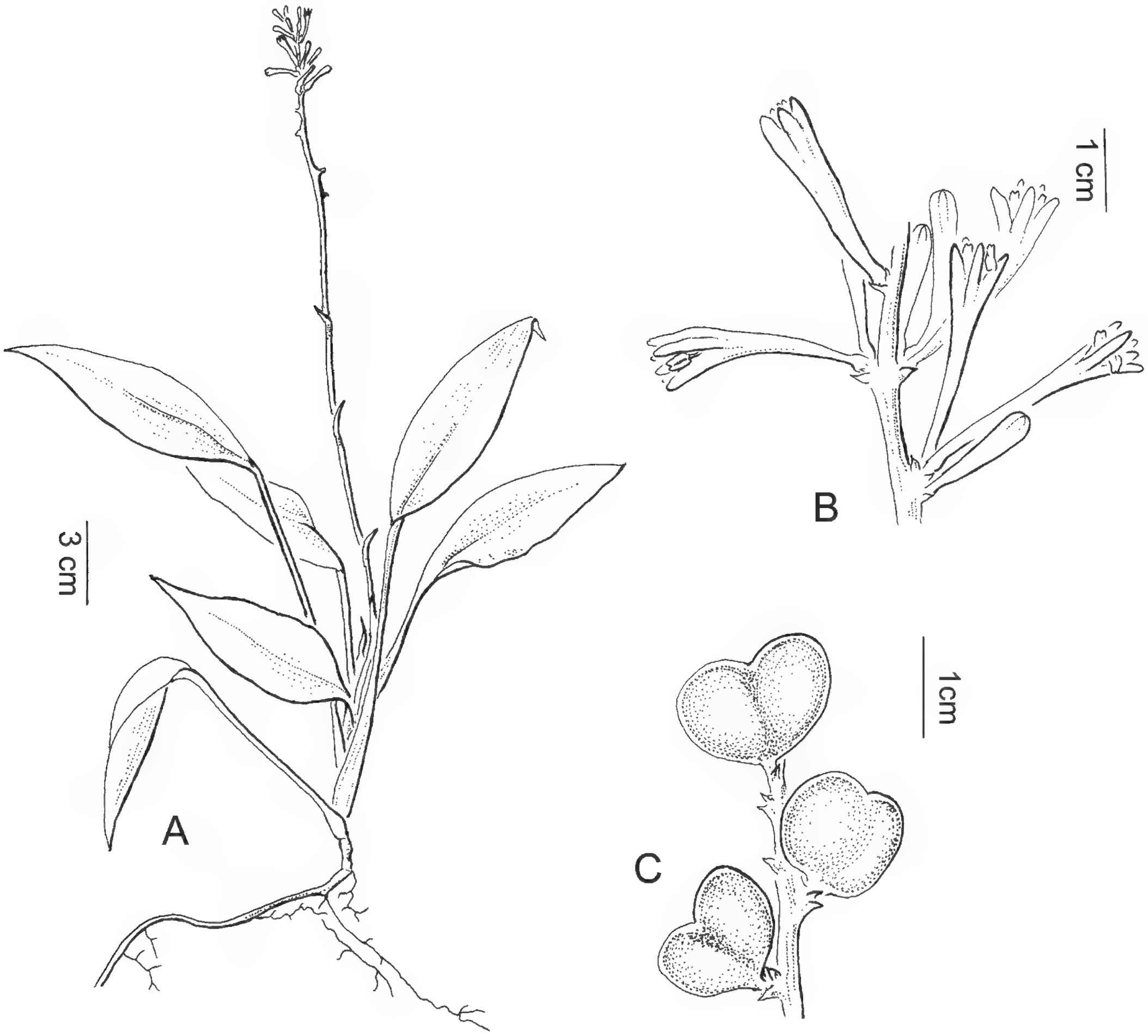

Figure 3. *Dracaena litoralis* Mwachala & Eb. Fisch. —A. Fertile habit. —B. Intact flowers from portion of inflorescence axis. —C. Fruits. Drawn from the paratype *G. Le Testu 970* (BR).

Acknowledgments. We are grateful to the directors of the herbaria at Meise (BR), Kew (K), Libreville (LBV), Paris (P), and Wageningen (WAG) for permitting us to study their collections and to the BIOTA program of the BMBF, PT-DLR Germany (grant number 01 LC0625C1), for funding the visits to the various herbaria.

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New Species, Combinations, and Lectotypifications in Neotropical and Northern Mexican *Frangula* (Rhamnaceae)

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Abstract. In preparing the family Rhamnaceae for an upcoming volume of *Flora Mesoamericana*, it became apparent, based on recent molecular work (Bolmgren & Oxelman, 2004; Bolmgren, pers. comm., 2013), as well as historical (Grubov, 1949; Kartesz & Gandhi, 1994), and personal morphological studies, that recognization of the genus *Frangula* Mill. is well supported. The emphasis of the current study has been on Mesoamerican species and four species from Mesoamerica, *F. circumscissa* A. Pool from Costa Rica, *F. darienensis* A. Pool from Panama, *F. grandiflora* A. Pool described from Honduras and also found in Chiapas, Mexico, *F. pendula* A. Pool described from Costa Rica and also found in Panama, and one species from Oaxaca, Mexico, *F. inconspicua* A. Pool, are published here as new. Four Mesoamerican species and two varieties published in *Rhamnus* L. are transferred to *Frangula* as: *F. breedlovei* (L. A. Johnst. & M. C. Johnst.) A. Pool [≡ *R. breedlovei* L. A. Johnst. & M. C. Johnst.], *F. mcvaughii* (L. A. Johnst. & M. C. Johnst.) A. Pool [≡ *R. mcvaughii* L. A. Johnst. & M. C. Johnst.], *F. oreodendron* (L. O. Williams) A. Pool [≡ *R. oreodendron* L. O. Williams], *F. wendtii* (Ishiki) A. Pool [≡ *R. wendtii* Ishiki], *F. capreifolia* var. *grandifolia* (M. C. Johnst. & L. A. Johnst.) A. Pool [≡ *R. capreifolia* var. *grandifolia* M. C. Johnst. & L. A. Johnst.], and *F. discolor* var. *mesoamericana* (L. A. Johnst. & M. C. Johnst.) A. Pool [≡ *R. sphaerosperma* var. *mesoamericana* L. A. Johnst. & M. C. Johnst.]. The following new combinations are made for five Mexican species north of the Flora Mesoamericana area: *F. chimalapensis* (R. Fernández) A. Pool [≡ *R. chimalapensis* R. Fernández], *F. hintonii* (M. C. Johnst. & L. A. Johnst.) A. Pool [≡ *R. hintonii* M. C. Johnst. & L. A. Johnst.], *F. longistyla* (C. B. Wolf) A. Pool [≡ *R. longistyla* C. B. Wolf], *F. scopulorum* (M. E. Jones) A. Pool [≡ *R. serrata* var. *scopulorum* M. E. Jones], and *F. surotatensis* (Gentry) A. Pool [≡ *R. surotatensis* Gentry]. Four South American species are transferred: *F. acuminata* (Maguire & Steyerm.) A. Pool [≡ *R. acuminata* Maguire & Steyerm.], *F. chimantensis* (Steyerm. & Maguire) A. Pool [≡ *R. chimantensis* Steyerm. & Maguire], *F. marahuacensis* (Steyerm. & Maguire) A. Pool [≡ *R. marahuacensis* Steyerm. & Maguire], *F. neblinensis* (Maguire & Steyerm.) A. Pool [≡ *R. neblinensis* Maguire & Steyerm.]. *Rhamnus sphaerosperma* var. *longipes* M. C. Johnst. & L. A. Johnst. (from Hispaniola and Puerto Rico) is transferred to *Frangula* and raised to the rank of species, necessitating the publication of the new name *F. longipedicellata* A. Pool. Lectotypes are designated for *F. polymorpha* Reissek, *R. citrifolia* Rusby, and *R. riojae* Perkins.

Key words: Frangula, IUCN Red List, Mesoamerica, Mexico, Rhamnaceae, *Rhamnus*, South America, West Indies.

The genus *Frangula* Mill. (Rhamnaceae) consists of approximately 50 species and is native to North America, the Neotropics, Europe, and Asia. Grubov (1949) published a worldwide revision of *Rhamnus* L. s.l. and provided names in *Frangula* for those species known to him. His generic recognition of *Frangula* was accepted in Europe for the Flora Europaea (Tutin, 1968) and for taxonomic treatments in North America (Kartesz & Gandhi, 1994; G. Nesom, Flora of North America, in prep.). However, most modern Neotropical works (e.g., Standley & Steyermark, 1949; Nowicke, 1971; Johnston & Johnston, 1978; Fernández N., 1986; Johnston, 2001; Steyermark & Berry, 2004) have continued to treat the species of *Frangula* in *Rhamnus*. Johnston and Johnston (1978), who recognized *Frangula* at the subgenus level within *Rhamnus*, provided a translation of the characters used by Grubov (1949 [Russian]) to distinguish *Frangula* from *Rhamnus*, and Kartesz and Gandhi (1994) provided a similar table of distinguishing characteristics, which is slightly revised here (Table 1). The most convincing characteristics for recognizing *Frangula* include the bud scales absent, the pyrenes (Fig. 1A) indehiscent, and the seeds smooth with a thickened cartilaginous basal rostrum that is exserted through the base of the pyrene. In contrast, in *Rhamnus*, the bud scales are present, the pyrenes (Fig. 1B) ventrally dehiscent, and the seeds (Fig. 1C) grooved, without a basal thickening and completely enclosed within the

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Table 1. Comparison of *Frangula* Miller with *Rhamnus* L.

	Frangula	*Rhamnus*
Bud scales	absent	present
Thorns	absent	present or absent
Leaves	alternate (rarely some opposite)	alternate or opposite (or both)
Flowers	bisexual, usually 5-merous (rarely 4-merous)	unisexual or bisexual, 4- or 5-merous, usually unisexual and 4-merous
Hypanthium	circumscissile far below sepal bases (rarely not circumscissile)	not circumscissile (rarely circumscissile at or just below sepal bases)
Sepals	fleshy with keel apparent	usually chartaceous with inconspicuous keel
Petals	well-developed, basally clawed	poorly developed, without claw, or sometimes absent in pistillate flowers
Ovary	usually 3-locular (rarely 2)	2- to 4-locular
Style/Stigma	style simple, usually included, with trifid stigma	style 2 to 4 deeply cleft, usually exserted, each with simple stigma
Pyrenes	indehiscent, open at base	dehiscent, closed at base before dehiscence
Seeds	without groove, with thickened basal rostrum exserted through base of pyrene	with groove, without thickened rostrum, totally contained in pyrene before dehiscence

pyrene before dehiscence. The species treated in this paper as *Frangula* are consistent with these characteristics. They also share the other characteristics of *Frangula* in being unarmed and having alternate leaves (leaves both alternate and opposite in *F. granulosa* [Ruiz & Pav.] Grubov), the flowers always bisexual (Fig. 1J–L), 5-merous with the hypanthium usually circumscissile (rarely not, cf. discussion for *F. breedlovei* (L. A. Johnst. & M. C. Johnst.) A. Pool), the sepals fleshy and distinctly adaxially keeled, the petals well developed with limb and claw, the style simple with a 3-lobed stigma (usually briefly so) that is usually included (sometimes equaling sepals, as in *F. longistyla* (C. B. Wolf) A. Pool), and the ovary 3-locular with three pyrenes usually developing. In contrast, *Rhamnus* often has branch tip thorns, alternate or opposite leaves, predominately unisexual flowers (Fig. 1D–I) that are 4- or 5-merous (usually 4-merous) with the hypanthium not circumscissile (rarely circumscissile at, or slightly below, the base of the sepals), the sepals chartaceous and inconspicuously keeled, the pistillate flowers often without petals or petals greatly reduced without a basal claw, the style usually deeply 2- to 4-parted and exserted, and the ovary 2- to 4-locular, with two to four pyrenes developing.

The molecular study of Bolmgren and Oxelman (2004) included 22 species of *Rhamnus* s.l., the seven species of *Frangula* from Europe, China, U.S.A., Mexico, and Brazil and from the three informal (i.e., not validly published) sections recognized by Grubov. While not answering all the possible generic questions in *Rhamnus*, this analysis was based on both chloroplast and nuclear sequence, *trnL-F* and ITS, respectively. Results found *Frangula* to be "a well supported monophyletic sister clade to the rest of *Rhamnus* in its widest sense" (Bolmgren & Oxelman, 2004: 386). This was a strong statement, supporting the recognition of *Frangula* at the genus level. A further, unpublished molecular study, including 25 species of *Rhamnus* s.l. (16 in *Frangula*, including *F. granulosa*, unusual in this genus in having the hypanthium not circumscissile and the leaves both alternate and opposite), further supports this conclusion (Bolmgren, 2013, pers. comm.).

The current study, while emphasizing the Mesoamerican species, provides names in *Frangula* for all species in the Western Hemisphere, for which the types have been examined and that can be confirmed as independent species, in need of recognition. There are ca. 44 species of *Frangula* in the Western Hemisphere with ca. 37 species from Mexico and the Neotropics. The 19 species names and two variety names published here add to the names previously published in *Frangula*, for Mexico and the Neotropics, by Reissek (1861), Grubov (1949), and Kartesz and Gandhi (1994). Remaining in *Rhamnus* s. str., for the Western Hemisphere, are ca. 18 species, with only one, *R. serrata* Schult., found in the Neotropics (Mexico and Guatemala). While previous studies of *Rhamnus* s.l. have relied on leaf characteristics (e.g., Standley & Steyermark, 1949; Johnston & Johnston, 1978; Johnston, 2001; Steyermark & Berry, 2004), a number of other characteristics are relevant to the distinction of the taxa, namely the persistence of stipules, inflorescence characteristics such as the pedicel length relative to the subtending petiole length, and sessile or pedunculate inflorescences (but both in a few species, such as *F. capreifolia* (Schltdl.) Grubov, *F. discolor* (Donn. Sm.) Grubov, and *F. marahuacensis* (Steyerm. & Maguire) A. Pool). Useful floral characteristics, in particular, include the hypanthium shape and whether the hypanthium is

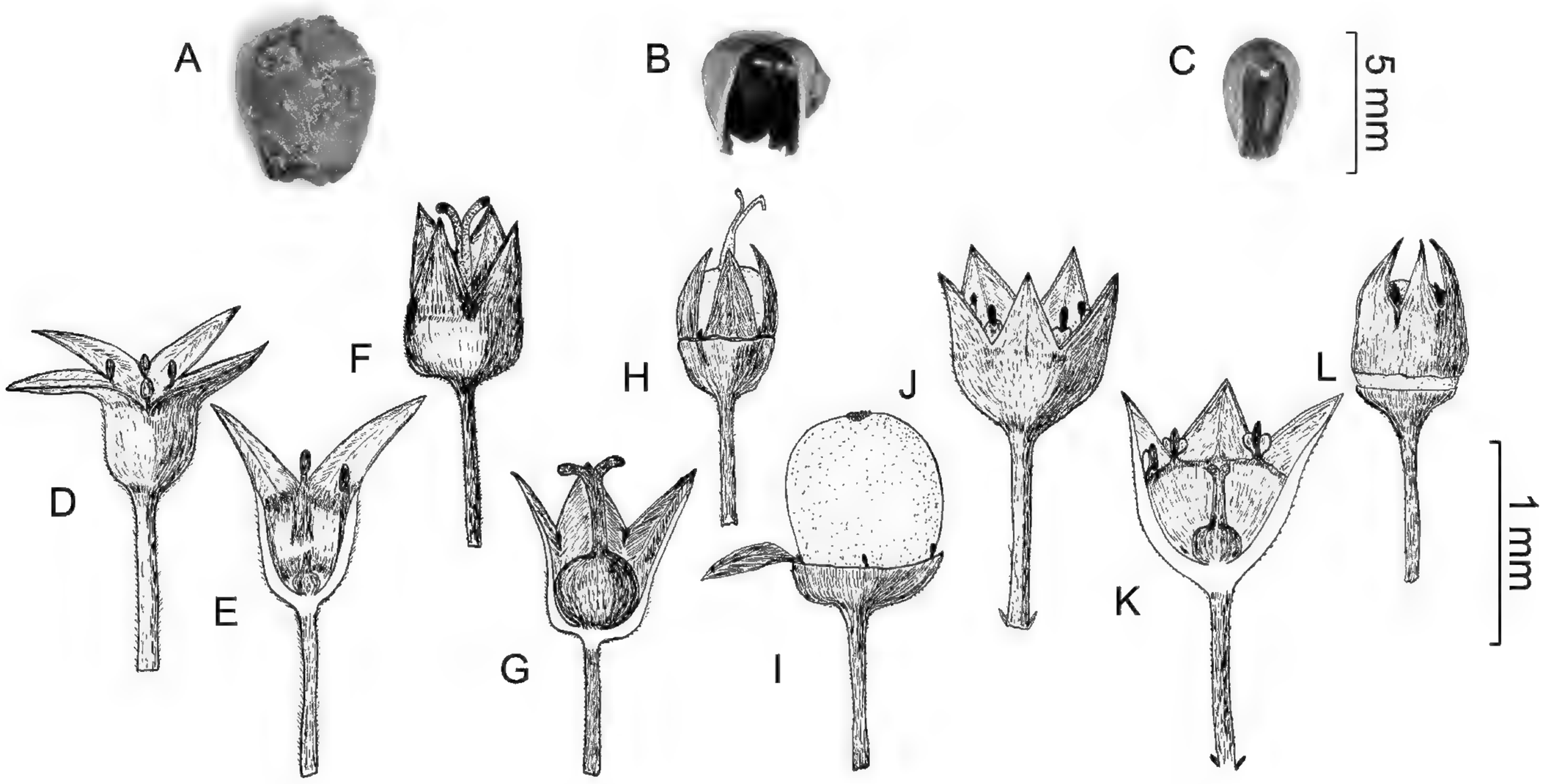

Figure 1. —A. *Frangula discolor* (Donn. Sm.) Grubov var. *discolor*. Young indehiscent pyrene with seeds exserted at base. Taken from *S. Lobo et al. 1075* (MO). B, C. *Rhamnus insula* Kellogg. —B. Dehiscent pyrene. —C. Grooved seed. B and C both from *E. Palmer 738* (MO). D–I. *Rhamnus* L. —D, E. Staminate flower, identified in original publication (Wolf, 1938: 8) as "*R. crocea ilicifolia* ♂ fresh material from RSA. Bot. Gard. Prop. No. 183." —F, G. Pistillate flower, in original publication as "*R. crocea ilicifolia* ♀ *C. B. Wolf 4748*" (RSA-6825). —H, I. Young fruit with non-circumscissile hypanthium, in original publication as "*R. crocea ilicifolia*♀ *C. B. Wolf 4630*" (RSA-6961). J–L. *Frangula* Mill. —J, K. Flower. —L. Immature fruit with circumscissile hypanthium. J–L in original publication as "*Rhamnus californica typica* fresh material from RSA. Bot. Gard. Prop. No. 1254"). D–L adapted from Wolf (1938: 8, fig. 1). Reproduced with the permission of the Archives of the Rancho Santa Ana Botanic Garden, Claremont, California, U.S.A.

circumscissile or not, the sepal length relative to hypanthium length, the sepal position as erect, spreading or recurved, and the ovary as glabrous or pubescent.

The conservation status has been estimated for each new taxon, according to IUCN (2012) Red List categories and criteria. However, these preliminary assessments are based only on the estimated extent of occurrence (EOO) and the area of occupancy (AOO), as taken from herbarium specimens, many of which were georeferenced from vague collection localities. Changes in occupancy (Bb, continuing decline, including decline in habitat quality and c, extreme fluctuation), potential threats and area size affected by threats (as criteria for IUCN size of location Ba), population reduction (A), and the number of mature individuals (C, D) are not known for any of the taxa treated here. Nearly all the species treated here are apparently restricted to relatively high elevations and, while most apparently do well in disturbed habitats, they are presumably to some degree subjected to threats.

1. Frangula acuminata (Maguire & Steyerm.) A. Pool, comb. nov. Basionym: *Rhamnus acuminata* Maguire & Steyerm., Mem. New York Bot. Gard. 51: 121. 1989. TYPE: Venezuela. Amazonas: Cerro de la Neblina, Cañon Grande, SSW of Cumbre Camp, 1050–1150 m, 25 Dec. 1957, *B. Maguire, J. J. Wurdack & C. K. Maguire 42496* (holotype, NY not seen, image, photo; isotypes, COL not seen, image, K not seen, image, MO, US not seen, image, VEN, not seen, image).

Maguire and Steyermark (1989) published three new species of *Rhamnus* from Cerro Neblina, two of which are considered herein as slight morphological variants of the same species, as *Frangula neblinensis* (Maguire & Steyerm.) A. Pool. Their third species, *F. acuminata*, initially seemed to represent another variant with leaves longer (13.5–18 × 5.5–7.2 cm vs. 5–9.5 × 2.5–5 cm in *F. neblinensis*) and less coriaceous (membranaceous with tertiary venation more or less flat on both surfaces vs. coriaceous and tertiary venation sulcate adaxially and more or less strongly elevated abaxially), variation that might have reflected population differences due to the collection of *F. acuminata* at slightly lower elevations (780–1500 m vs. 1600–2000 m in *F. neblinensis*). However, in addition to the leaf differences, the flowers also distinguish the species in that in *F. acuminata* the hypanthial width is equal to the floral length and the sepals are smaller than the hypanthi-

um while in *F. neblinensis* the hypanthial width is 2/3 the length of the flower and the sepals are about equal to the length of the hypanthium.

Frangula acuminata is sometimes confused with *F. ulei* (Pilg.) Grubov [≡ *Rhamnus ulei* Pilg.] from Guyana and Bolívar, Venezuela. The latter species differs in its smaller flowers (1.7–2 mm vs. ca. 2.5 mm in *F. acuminata*), with the hypanthium densely dull brown tomentose (vs. sparse, appressed ferrugineous indument), the ovary pubescent (vs. glabrous), and the inflorescences sessile and consistently without peduncle (vs. the inflorescences either with or without peduncle).

2. Frangula breedlovei (L. A. Johnst. & M. C. Johnst.) A. Pool, comb. nov. Basionym: *Rhamnus breedlovei* L. A. Johnst. & M. C. Johnst., Fl. Neotrop. 20: 52. 1978. TYPE: Mexico. Chiapas: Mpio. Chamula, SE side of Zontehuitz near summit, 2850 m, 30 July 1964, *D. E. Breedlove 6724* (holotype, MICH; isotypes, ENCB not seen, F).

Frangula breedlovei is unusual in being one of only four species of *Frangula* studied (i.e., *F. oreodendron* (L. O. Williams) A. Pool, *F. granulosa*, and *F. goudotiana* (Triana & Planch.) Grubov s. str.), with a hypanthium that is noncircumscissile, with the sepals, petals, and stamens tardily deciduous from the rim of the hypanthium. This condition more typically occurs in *Rhamnus*, whereas the hypanthium is otherwise circumscissile with the sepals, petals, and stamens lost with the upper half of the hypanthium for other *Frangula*. Nonetheless, *F. breedlovei*, *F. oreodendron*, *F. granulosa*, and *F. goudotiana* s. str. all share the most compelling characteristics separating *Frangula* from *Rhamnus*: bud scales absent, pyrenes indehiscent, and seeds smooth with a thickened cartilaginous basal rostrum exserted through the base of the pyrene. In addition, recent molecular work that included one of these species, *F. granulosa* (Bolmgren, 2013, pers. comm.), strongly supports its placement in this genus.

3. Frangula capreifolia (Schltdl.) Grubov, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 8: 278. 1949, as "caprifolia." Basionym: *Rhamnus capreifolia* Schltdl., Linnaea 15: 464. 1841, as "capreaefolia." TYPE: Mexico. Veracruz: in saxosis Malpays de Naulingo, *C. J. W. Schiede s.n.* (lectotype, designated by Johnston & Johnston [1978: 32], HAL-21748 not seen, image; isolectotype, W not seen).

3a. Frangula capreifolia (Schltdl.) Grubov var. **capreifolia.**

Rhamnus capreifolia var. *matudae* L. A. Johnst. & M. C. Johnst., Fl. Neotrop. 20: 33. 1978, as "capraeifolia var. matudai," syn. nov. TYPE: Mexico. Veracruz: Encinal, Maltrata, 12 May 1937, *E. Matuda 1383* (holotype, NY; isotypes, A, F, K not seen, image, MICH, MO, NA not seen).

In the original protologue of *Rhamnus capreifolia*, Schlechtendal included specimens made at four localities each with collector and corresponding month and phenological state. Grubov (1949: 278) indicated the type as made by *Schiede* in "sylvis Jalapensibus," one of the original collectors and syntype localities. However, at HAL there are two collections of *Schiede* with this collection information (HAL-105597 and HAL-21523). Later, Johnston and Johnston (1978: 32), without discussion, cited as the type *Schiede s.n.* (HAL-21748), "in saxosis Malpays de Naulingo, prope Jalapa, fl, Apr 1829," another collection (or collections) cited by Schlechtendal. There are two collections of Schiede at HAL made at this locality in April, both in flower (HAL-107596, also in fruit), but only one with the accession number 21748 and it can unambiguously be accepted as the lectotype.

Johnston and Johnston (1978: 30) separated *Rhamnus capreifolia* var. *matudae* from the typical variety based on the "macroscopically conspicuous dense lateral pubescence" of the major veins on the abaxial leaf surfaces of variety *matudae* versus the absence of this pubescence in the typical variety. However, I found this character to be variable in *Frangula capreifolia* var. *capreifolia* throughout its range (eastern Mexico, Tamaulipas to eastern Oaxaca and Veracruz [Johnston & Johnston, 1978]) as well as variable in other *Frangula* studied (*F. breedlovei*, both varieties of *F. discolor* (Donn. Sm.) Grubov, *F. mucronata* (Schltdl.) Grubov, *F. pendula* A. Pool, and *F. pringlei* (Rose) Grubov). Since no other characters were found that could be used to recognize *F. capreifolia* var. *matudae*, the name is synonymized to the autonym.

3b. Frangula capreifolia var. **grandifolia** (M. C. Johnst. & L. A. Johnst.) A. Pool, comb. nov. Basionym: *Rhamnus capreifolia* var. *grandifolia* M. C. Johnst. & L. A. Johnst., Fl. Neotrop. 20: 34. 1978, as "capraeifolia var. grandifolia." TYPE: Mexico. Chiapas: Rancho Phoenix, Monserrate, 1 May 1926, *C. A. Purpus 10201* (holotype, M not seen; isotype UC, not seen).

Rhamnus pompana M. C. Johnst. & L. A. Johnst., Fl. Neotrop. 20: 38. 1978, syn. nov. TYPE: Mexico. Veracruz: near Jalapa, 31 Mar. 1899, *C. G. Pringle*

8079 (holotype, M not seen; isotypes, A not seen, BM not seen, image, E not seen, image, F not seen, image, K not seen, image, HBG not seen, image, L not seen, LL not seen, image, MICH not seen, image, MO, NY, RSA not seen, image, TEX not seen, UC not seen, U, not seen, W not seen).

Johnston and Johnston (1978) also cited and annotated as an isotype a specimen of *C. A. Purpus 10201* at GH, but the date on this collection is April rather than May as noted for the holotype. As Purpus was casual in recording collection dates and did not use chronological collection numbers, assigning the same number to collections of what he believed to be the same taxon regardless of when they were collected (Sousa, 1969), it is not possible to know if this is an actual isotype or from a separate gathering.

Johnston and Johnston (1978) apparently segregated *Rhamnus pompana*, which they recognized from Hidalgo and Veracruz in Mexico, from *R. capreifolia* var. *grandifolia*, based on the smaller leaf size and flowers. However, flowers from the type and other specimens cited by Johnston and Johnston, as seen in this study (2–3 mm), fit easily into the range of *Frangula capreifolia* var. *grandifolia* (2–3.5 mm) and the leaves of the type and other specimens as indicated above (5–10 × 2.5–4.5 cm) do fit within the lower range for other specimens of *F. capreifolia* var. *grandifolia* (total range, 5–20 × 2.5–8.5 cm). No characters were found to separate *R. pompana* from *F. capreifolia* var. *grandifolia*, which is found in Mexico (Hidalgo [e.g., *J. D. Flores M. 235*, MO], Veracruz [e.g., *M. Chazaro B. & P. Sánchez 2209*, MO], Puebla [e.g., *A. J. Sharp 45307*, MO], Oaxaca [e.g., *R. Torres C. & C. Martínez R. 4851*, MO], and Chiapas [e.g., *A. Reyes-García et al. 1590*, MO]), Guatemala (e.g., *E. Contreras 4873*, MO), El Salvador (e.g., *K. J. Sidwell et al. 824*, MO), and Costa Rica (e.g., *G. Rivera 382*, MO).

4. Frangula chimalapensis (R. Fernández) A. Pool, comb. nov. Basionym: *Rhamnus chimalapensis* R. Fernández, Polibotanica 1: 4. 1996. TYPE: México. Oaxaca: San Miguel Chimalapa, arroyo El Caracol, donde desemboca el Río Portamonedas, ca. 1 km al NW de Congregación Benito Juárez, ca. 39 km al N de San Pedro Tepanatepec, 16°43′N 94°09′W, 950 m, *S. Maya 521* (holotype, ENCB not seen; isotypes, CHAPA not seen, MO).

Fernández N. (1996) provided a key separating *Frangula chimalapensis* from the similar *F. palmeri* (S. Watson) Grubov on the basis of leaf size (blade usually greater than 8 cm vs. usually less than 8 cm in *F. palmeri*, petiole 8–10 mm vs. 2–5 mm), number of flowers per inflorescence (3 to 5 vs. 5 to 10), and fruit size (5–7 mm vs. 7–8 mm). To this can be added that in fruit the pedicels of this species are approximately equal in length to the subtending petioles, while in *F. palmeri* the pedicels are twice as long as the petioles.

5. Frangula chimantensis (Steyerm. & Maguire) A. Pool, comb. nov. Basionym: *Rhamnus chimantensis* Steyerm. & Maguire, Mem. New York Bot. Gard. 17(1): 451. 1967. TYPE: Venezuela. Bolívar: Chimantá Massif, E-central portion of summit of Apácara-tepuí, 2450–2500 m, 21–22 June 1953, *J. A. Steyermark 75946* (holotype, NY not seen, image; isotypes, MO-2012040, MO-2011382, VEN not seen, image).

Rhamnus chimantensis was described from and is endemic to the Guayana region of Venezuela. The species was later treated in Johnston and Johnston (1978) as a synonym of a variable *R. goudotiana* Triana & Planch. [≡ *Frangula goudotiana* (Triana & Planch.) Grubov]. Now recognized as *F. chimantensis*, the species differs from *F. goudotiana* in its unusual inflorescence, which is a pseudo-raceme simple or once branched at the base with each flower subtended by a large and persistent bract, the stipules persistent after the leaves are lost, and the upper portion of the hypanthium, with sepals, stamens, and petals attached, circumscissile and lost early in fruit development. This is in contrast to *F. goudotiana* with the inflorescence a fascicle of flowers with the bracts restricted to the base of the fascicle, the stipules lost before or with the dehiscence of the leaves, and the hypanthium not circumscissile, with the floral perianth and androecium lost independently and late in fruit development. Triana and Planchon (1872) cited in the protologue of *R. goudotiana* another collection, *Triana*, but without specifying a collection number. Johnston and Johnston (1978: 57) include in exsiccate *Triana 3529* (BM, NY, US) and note that this is the syntype not chosen by them (1978: 56) as the lectotype for *F. goudotiana*, *J. Goudot s.n.* (P). *Triana 3529* (based on observations from the duplicate at MO and the image of the duplicate at P) differs from the description in the original protologue in having the undersurface of the leaf the same color as the veins (brown-green) versus in the protologue: "subtus pallidioribus fusco-venosis [below paler (than the upper surface) dark brown veined]" (Triana & Planchon, 1872: 379). *Triana 3529* also differs from the *Goudot* specimen in having a circumscissile hypanthium. I have seen a number of specimens of both forms of *F. goudotiana* and suggest that further study may prove them to be independent species.

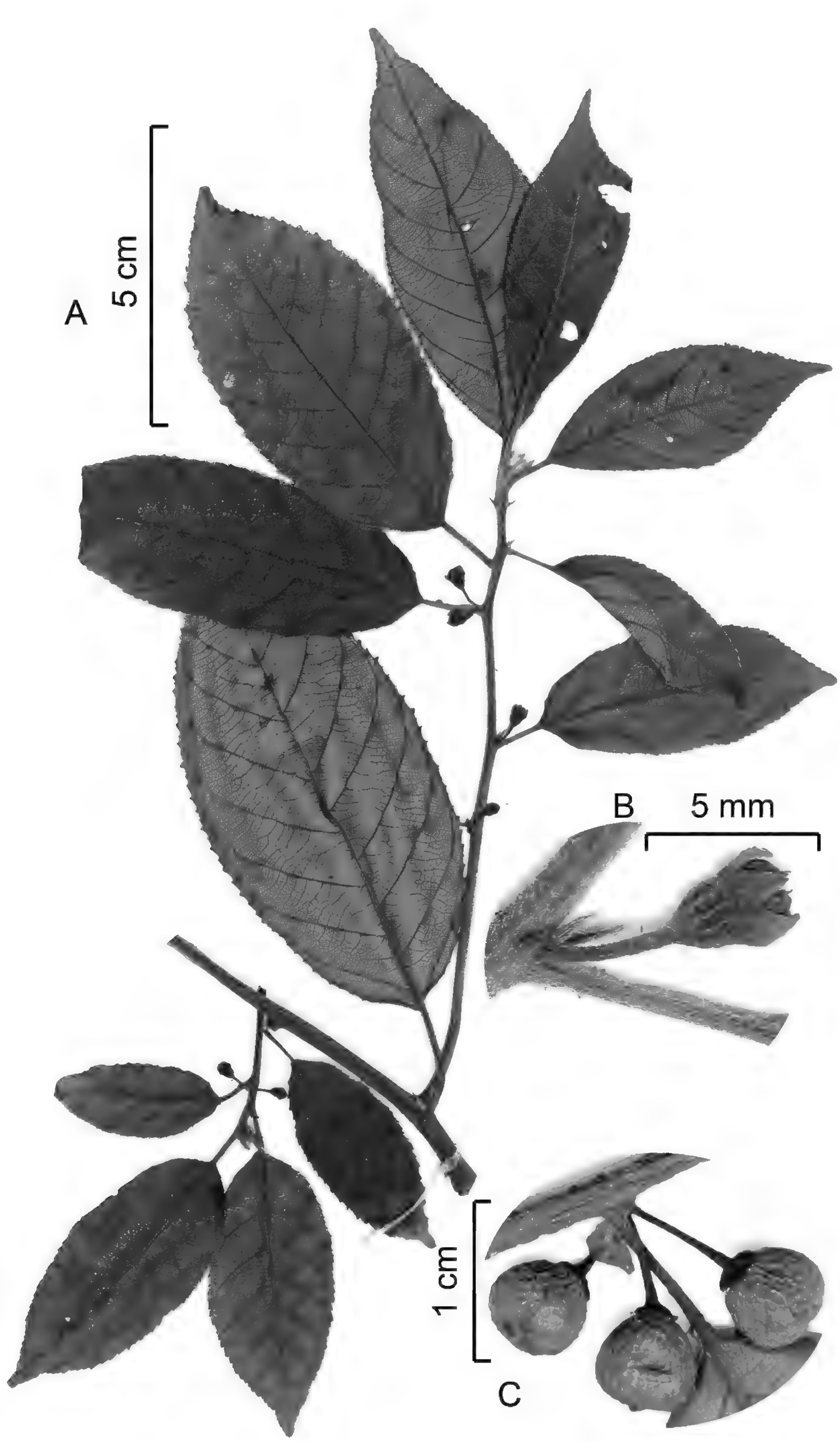

Figure 2. *Frangula circumscissa* A. Pool. —A. Flowering branch. —B. Flower in leaf axil. —C. Infructescence in leaf axil. A, B taken from the holotype *L. Acosta & V. Ramírez 563* (MO); C from *G. A Mora V. 414* (MO).

6. Frangula circumscissa A. Pool, sp. nov. TYPE: Costa Rica. Cartago: Paraíso, Parque Nacional Tapantí, Macizo de La Muerte, cuenca del Reventazón, colecta a orilla de calle desde el cruce de Río Humo al Túnel, 9°42′10″N 83°47′20″W, 1700 m, 8 Mar. 2000, *L. Acosta & V. Ramírez 563* (holotype, MO isotype, INB not seen). Figure 2.

Diagnosis. *Frangula circumscissa* A. Pool is similar to *F. oreodendron* (L. O. Williams) A. Pool, differing in membranaceous leaves and the hypanthium narrower and circumscissile.

Small trees or shrubs, 2–6 m, young branches densely tomentose or with abundant appressed and ascending, pale red trichomes. Leaves with blades 6.2–15.5 × 2.3–5 cm, elliptic, membranaceous, both surfaces of similar color, 8 to 10 pairs of lateral veins, these at 45° angles to midrib, adaxial surface with trichomes, appressed to ascending, mainly on midrib and lateral veins, abaxial surface glabrous or with trichomes restricted to midrib and lateral veins, these appressed to ascending or somewhat spreading, lamina base cuneate, sometimes inequilateral, blade margin nearly flat to recurved, serrate to serrulate with 5 to 8 teeth/centimeter, apex acute to short-acuminate or obtuse and then shortly cuspidate, tip mucronate; stipules persistent into early fruit, 2–3.5 mm; petiole 7–30 mm. Inflorescence a sessile fascicle with 1 to 4 flowers; flowers on pedicels 4–8 mm, 1/2–3/4 length of subtending petiole (of similar size, 1/3–3/4 length of petiole in fruit). Flowers 2.75–3.5 mm, with the hypanthium narrowly funnelform to tubular, 2–2.5 × 2.25–2.75 mm, hypanthium width ca. 3/4 to nearly equaling the length of the flower, with sparse to scattered trichomes that are appressed and ascending, with circumscissile dehiscence, the sepals, petals and stamens lost early with the upper portion of the hypanthium; sepals 0.75–1.25 mm long and wide, 1/2 hypanthium in length, erect; petals 1–1.5 mm long and wide, weakly apically bi-lobed, glabrous, apically exserted; stamens with filaments 0.6–0.75 mm, anthers 0.4–0.6 mm, not visible free from petals; ovary glabrous, style 1–1.2 mm, stigma 3-lobed. Young fruits 2- to 4-fascicled, glabrous, globose, lines not apparent; all sepals, petals and stamen filaments rapidly lost, hypanthium remnant 1–1.25 × 3–3.5 mm, not angled; pyrenes not seen.

Phenology. *Frangula circumscissa* has been collected in flower in March and September.

This new species, known only from Costa Rica, has previously been most often confused with *Frangula oreodendron* of Costa Rica and Panama. The latter differs in having leaves with firm texture (vs. membranaceous in *F. circumscissa*) and hypanthia that are broadly campanulate, (1.25–)1.5–2.75 × (2.3–)3–4.5 mm, and not circumscissile, the sepals, petals, and stamens tardily and separately lost in fruit. In *F. circumscissa*, the hypanthia are narrowly funnelform to tubular, 2–2.5 × 2.25–2.75 mm, and circumscissile, with the sepals, petals, and stamens lost with the dehiscence of the apical portion of the hypanthium. The new species is also similar to *F. mucronata* found to the north, from Mexico, Guatemala, and El Salvador. The latter differs in its leaves usually narrower (1.5–3 cm vs. 2.3–5 cm in *F. circumscissa*), often pilose, with acuminate apices on usually smaller petioles (3.5–10 mm vs. 7–30 mm in *F. circumscissa*), and the pedicels often equal or slightly longer than the subtending petioles in flower and especially in fruit. In the new species, the pedicels are shorter than the subtending petioles in flower and fruit. While mature pyrenes of *F. circumscissa* were not observed, the immature pyrenes are of the type typical of the genus, open at the base with the horny base of seeds exserted.

Distribution. This species is apparently endemic to north central Costa Rica, where it has been collected between 1300 and 2000 m.

IUCN Red List category. The new species is assessed as DD or Data Deficient, according to IUCN (2012) criteria. *Frangula circumscissa* is known from only six collections from five localities in north central Costa Rica, made between 1300 and 2000 m in elevation. The EOO is estimated at ca. 2500 km² and the minimum AOO is ca. 20 km².

Paratypes. COSTA RICA. **Alajuela:** San Ramon, Reserva Biol. Monteverde, Cordillera de Tilarán, Valle del Río Peñas Blancas, 10°19′12″N 084°46′12″W, 22 July 1993, *E. Bello C. 5162* (CR not seen, MO); Los Angeles, Reserva Biol. Alberto M. Brenes, sendero entre la Estación y Volcán Muerto, 10°11′50″N 084°37′00″W, 15 Sep. 1994, *G. Herrera Ch., V. Mora & H. Perez Z. 7308* (CR not seen, F). **Cartago:** Paraiso, Parque Nac. Tapantí, Valle del Reventazón, Sector Dos Amigos, Sendero Rancho Negro, 09°42′10″N 083°47′20″W, 9 Dec. 1994, *G. A. Mora V. 414* (INB not seen, MO). **Heredia:** Yerba Buena, NE of San Isidro, 10°01′12″N 084°00′36″W, 28 Feb. 1926, *P. C. Standley & J. Valerio R. 49997* (US); original label lost "**Puntarenas** & **Alajuela:** Monteverde Reserve, 2–5 km E and SE of Monteverde, 10°18′N 084°06′W," s.d., *V. J. Dryer s.n.* (F).

7. Frangula darienensis A. Pool, sp. nov. TYPE: Panama. Darien: Cerro Tacarcuna massif, W ridge, vic. of summit camp, lower montane wet forest, 1500–1600 m, 5 Feb. 1975, *A. Gentry & S. Mori 14160* (holotype, MO). Figure 3.

Diagnosis. *Frangula darienensis* A. Pool is similar to *F. pubescens* (Ruiz & Pav.) Grubov, differing in its persistent stipules, the oblanceolate to narrowly oblanceolate, membranaceous leaves drying on adaxial surface with bluish cast, and the indumentum of the abaxial surface including compound trichomes with tortuous arms from a common base, the hypanthium with off-white, appressed, ascending trichomes, and petals minutely apically retuse.

Treelet, ca. 4 m, young branches sparsely to densely tomentose with pale gold to red-gold

Figure 3. *Frangula darienensis* A. Pool. —A. Flowering branch. —B. Inflorescence in leaf axil with one flower and one immature fruit. —C. Infructescence in leaf axil, with two immature fruits. A, B taken from the holotype *A. Gentry & S. Mori 14160* (MO); C from *A. Gentry & S. Mori 13982* (MO).

trichomes. Leaves with blades 5–10 × 2–3.5 cm, oblanceolate to narrowly oblanceolate, membranaceous, bicolored, with the adaxial surface drying with bluish cast, 6 to 10 pairs of lateral veins, these at 45° angles to midrib, adaxial surface with appressed, ascending to spreading trichomes on midrib and lateral veins, otherwise glabrous, abaxial surface with all orders of venation with numerous trichomes appressed and ascending to spreading, the trichomes simple and solitary and in small tufts, and compound

with tortuous arms from a common stalk, lamina base cuneate to attenuate, sometimes inequilateral, blade margin flat, serrulate or with teeth overlapping on adaxial surface, with 4 to 6 teeth/centimeter, apex obtuse then cuspidate, tip mucronate or not; stipules persistent at least into early fruiting, 2.5–3.5 mm; petioles 7–10 mm. Inflorescence a sessile fascicle, a pedunculate cyme, or a pedunculate compound cyme, each fascicle with 1 or 2 flowers; peduncle 0–7 mm, slightly to probably much shorter than subtending petiole (similar in fruit); flowers on pedicels ca. 4.25 mm, 2/3 the length of peduncle when present, pedicels ca. 2/3 the length of subtending petiole (8–10 mm in fruit, slightly longer to 10 times longer than peduncle (when present) and 5/4 the length of subtending petiole). Flowers ca. 3.2 mm, with the hypanthium tubular, ca. 1.8 × 2.1 mm, hypanthium width ca. 2/3 the flower length, with numerous appressed and ascending trichomes, with circumscissile dehiscence, the sepals, petals and stamens lost early with upper portion of hypanthium; sepals ca. 1.5 × 1 mm, slightly shorter than the hypanthium length, erect; petals ca. 0.7 × 1 mm, minutely apically retuse, abaxially pubescent on midrib, exserted; stamens with filaments not known, anthers ca. 0.5 mm, not visible free from petals; ovary with dense, long trichomes, style not known, stigma not known. Young fruits solitary, with numerous trichomes, obovoid, lines not observable; all sepals, petals and stamen filaments rapidly lost with circumscissile dehiscence of hypanthium, hypanthium remnant 0.5–0.75 × 2.5–2.8 mm, not angled; pyrenes not known.

Phenology. *Frangula darienensis* has been collected in flower in February.

Frangula darienensis is known from only two collections from Cerro Tacarcuna, Darien, Panama. Only one flower was seen, which was not dissected. The subtending leaf was lost from one of the two immature fruits observed, and it was not possible to see the peduncle of the remains of a third immature fruit. With its tubular hypanthium with erect sepals, often pedunculate inflorescence, and pubescent ovary, this species is morphologically closest to the Andean species *F. pubescens* (Ruiz & Pav.) Grubov, which was treated by Johnston and Johnston (1978) as part of their concept of an extremely variable *Rhamnus sphaerosperma* var. *pubescens* (Reissek) M. C. Johnst. (cf. discussion for *F. polymorpha* Reissek and *F. pubescens*). *Frangula darienensis* differs from *F. pubescens* in its retained stipules (vs. caducous in flower in *F. pubescens*), the hypanthium with off-white, appressed, ascending trichomes (vs. ferruginous tomentose), the petals minutely apically retuse (vs. strongly bi-lobed) and the oblanceolate to narrowly oblanceolate, membranaceous leaves drying with the adaxial surface with bluish cast and the trichomes on the abaxial blade surface including compound forms with tortuous arms from a common base. In *F. pubescens* the leaves are usually wider, elliptic, firm to subcoriaceous, drying green to brown, and rarely nearly black, with only simple solitary and tufted trichomes observed.

Distribution. The new species is apparently endemic to Cerro Tacarcuna, Darien, Panama, where it has been collected in elfin or lower montane wet forest between 1500 and 1850 m in elevation.

IUCN Red List category. *Frangula darienensis* is assessed as DD or Data Deficient, according to IUCN (2012) criteria. As this new species is known from only two collections made at the type locality, the EOO and the minimum AOO were not calculated.

Paratype. PANAMA. **Darien:** Top of W peak of Cerro Tacarcuna massif, 28 Jan. 1975, *A. Gentry & S. Mori 13982* (MO-2294408, MO-3100499).

8. Frangula discolor (Donn. Sm.) Grubov, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 8: 274. 1949. Basionym: *Rhamnus capreifolia* var. *discolor* Donn. Sm., Bot. Gaz. 18: 200. 1893, as "capreaefolia." *Rhamnus discolor* (Donn. Sm.) Rose, Contr. U. S. Natl. Herb. 8: 51. 1903, non *Rhamnus discolor*, Lesq., Rep. (Annual) U. S. Geol. Geogr. Surv. Territ. 6: 398. 1873. Replacement name: *Rhamnus sharpii* M. C. Johnst. & L. A. Johnst., Fl. Neotrop. 20: 74. 1978. Guatemala. Alta Verapaz, Cobán, 4300 ft., Aug. 1885, *H. von Türckheim 710* (holotype, US; isotypes, F, NY, US).

8a. Frangula discolor (Donn. Sm.) Grubov var. **discolor**.

8b. Frangula discolor var. **mesoamericana** (L. A. Johnst. & M. C. Johnst.) A. Pool, comb. nov. Basionym: *Rhamnus sphaerosperma* var. *mesoamericana* L. A. Johnst. & M. C. Johnst., Fl. Neotrop. 20: 64. 1978. TYPE: Guatemala. [in woods at Acetuna] near Guatemala, July 1860, *S. Hayes s.n.* (holotype, US-355630; isotypes, F, F fragm. at GH).

This variety was originally described within the species *Rhamnus sphaerosperma* Sw. *Frangula discolor* var. *mesoamericana* is similar to *F. discolor* var. *discolor* and both varieties differ from *F. sphaerosperma* (Sw.) Kartesz & Gandhi (endemic to Jamaica and Cuba) in the early caducous stipules (vs.

retained stipules in *F. sphaerosperma*), the pedicels often longer, 1.5–7 mm in flower and 2.5–14 mm in fruit (vs. 1.5–3 mm and 1.5–4 mm), the hypanthium more or less tubular (vs. campanulate), the petals and anthers only apically exserted (vs. well-exserted), and by the presence of appressed sessile stellate trichomes on the abaxial surface of the leaves (vs. lacking this type of trichome). *Frangula discolor* var. *mesoamericana* differs from typical *F. discolor* only in the glabrous ovaries and fruits of the former and pubescent ovary and fruits of the latter. *Frangula discolor* itself was first published as *R. capreifolia* var. *discolor* Donn. Sm. Johnston and Johnston (1978) treated this taxon at the species level, with the replacement name *R. sharpii* M. C. Johnst. & L. A. Johnst. *Frangula discolor* differs from *F. capreifolia* in the presence of appressed sessile stellate trichomes on the abaxial leaf surface (vs. absent in *F. capreifolia*), by the hypanthium more or less tubular and densely tomentose (vs. campanulate and sparsely to abundantly pilose), and by the sepals erect to spreading (vs. spreading to recurved).

Frangula discolor var. *mesoamericana* is known from Chiapas, Mexico (e.g., *D. E. Breedlove 11188*, MICH) to northern Nicaragua (e.g., *J. Pipoly 5151*, TEX) and has a smaller known geographic range than the typical variety, which ranges as far north as Colima, Mexico (e.g., *A. C. Sanders et al. 10713*, MO), and south to northern Panama (e.g., *S. Mori & J. Kallunki 5620*, MO). *Frangula discolor* var. *mesoamericana* is most common in Honduras (e.g., *P. House & R. Andino 970*, MO), while *F. discolor* var. *discolor* is most common in Chiapas, Guatemala, Costa Rica, and northern Panama, and has not been collected in Honduras.

9. Frangula grandiflora A. Pool, sp. nov. TYPE: Honduras. Lempira: Norte Río Arcágual, filo N del Camp. Arcágual, 13 km al SO de Gracias, en el Parque Nac. de Celaque, 14°34′N 88°41′W, 2700 m, 15 May 1992, *D. Mejía & T. Hawkins 101* (holotype, MO; isotypes, EAP not seen, HEH not seen, MEXU, TEFH not seen, TEX). Figure 4.

Diagnosis. *Frangula grandiflora* A. Pool is similar to *F. capreifolia* var. *grandifolia* (M. C. Johnst. & L. A. Johnst.) A. Pool, differing in the larger flowers (4–5.75 mm), with the hypanthium funnelform, longer pedicels (10–13 mm in flower, 12–19 mm in fruit), and the leaves subcoriaceous.

Trees or shrubs, 4.5–15 m, young branches densely tomentose to pilose, with red-gold trichomes. Leaves with blades 7.6–20.7 × 2.6–7.5 cm, oblong or elliptic, subcoriaceous, both surfaces of similar color, 8 to 11 pairs of lateral veins, lateral veins at 45° angles to midrib, adaxial surface glabrous or with a few appressed trichomes on midrib, or the midrib and lateral veins densely pilose, abaxial surface with trichomes on midrib and lateral veins and sometimes on all venation, the trichomes mixed, with small and longer tortuous and tufted and sometimes also longer, straight and spreading, solitary or in tufts of 2, without macroscopically conspicuous concentration of trichomes along sides of midrib and/or in angles of lateral veins, lamina base cuneate or rounded, margin strongly recurved with 3 or 4 teeth/centimeter, the teeth usually consisting only of apical glands, less frequently weakly serrulate, blade apex acute or short-acuminate, tip often mucronate; stipules very early caducous, ca. 2 mm; petiole 10–20 mm. Inflorescence a sessile fascicle with 3 to 5 flowers; pedicels 10–13 mm, equal in length to subtending petiole to slightly longer, pedicels in fruit 12–19 mm, and 3/4 to 3/2 times the length of subtending petioles. Flowers 4–5.75 mm, with the hypanthium funnelform, 2.5–3.25 × 3.2–4.5 mm, hypanthium width less than length of flower, densely tomentose, with circumscissile dehiscence, the sepals, petals, and stamens lost early with upper portion of hypanthium; sepals 1.5–2.5 × 1.25–1.5 mm, shorter than hypanthium, erect to spreading; petals ca. 1.2 mm long and wide, slightly apically bi-lobed, abaxially minutely puberulent medially, slightly exserted; stamens (perhaps young) with filaments ca. 0.9 mm, anthers ca. 0.8 mm, not visible free from petals; ovary with dense long trichomes, style ca. 1 mm, stigma 3-lobed. Young fruits 1- or 2-fascicled, with numerous trichomes, globose to obovoid, lines not noticeable; all sepals, petals or stamen filaments rapidly lost with circumscissile dehiscence of upper hypanthium, hypanthium remnant 0.75–1.5 × 3–3.25 mm, not angled; pyrenes 3, ca. 6 × 5 mm.

Phenology. *Frangula grandiflora* was collected in flower only in the month of May.

The new species is unusual in its robust pedicels and large flowers. In the Neotropics only *Frangula longistyla* has a flower that is similar in size (up to 4.75 mm) with *F. grandiflora* (4–5.75 mm). *Frangula longistyla* differs in having a tubular hypanthium (vs. funnelform in *F. grandiflora*), sporadically retained stipules (vs. consistently early caducous), and membranaceous leaves (vs. subcoriaceous). *Frangula capreifolia* var. *grandifolia*, with its early caducous stipules, sessile fascicles, and pubescent ovaries and fruits, is the taxon perhaps most superficially similar to *F. grandiflora*. *Frangula capreifolia* var. *grandifolia* differs in its membranaceous leaves (vs. subcoriaceous in *F. grandiflora*), pedicels 2.5–10

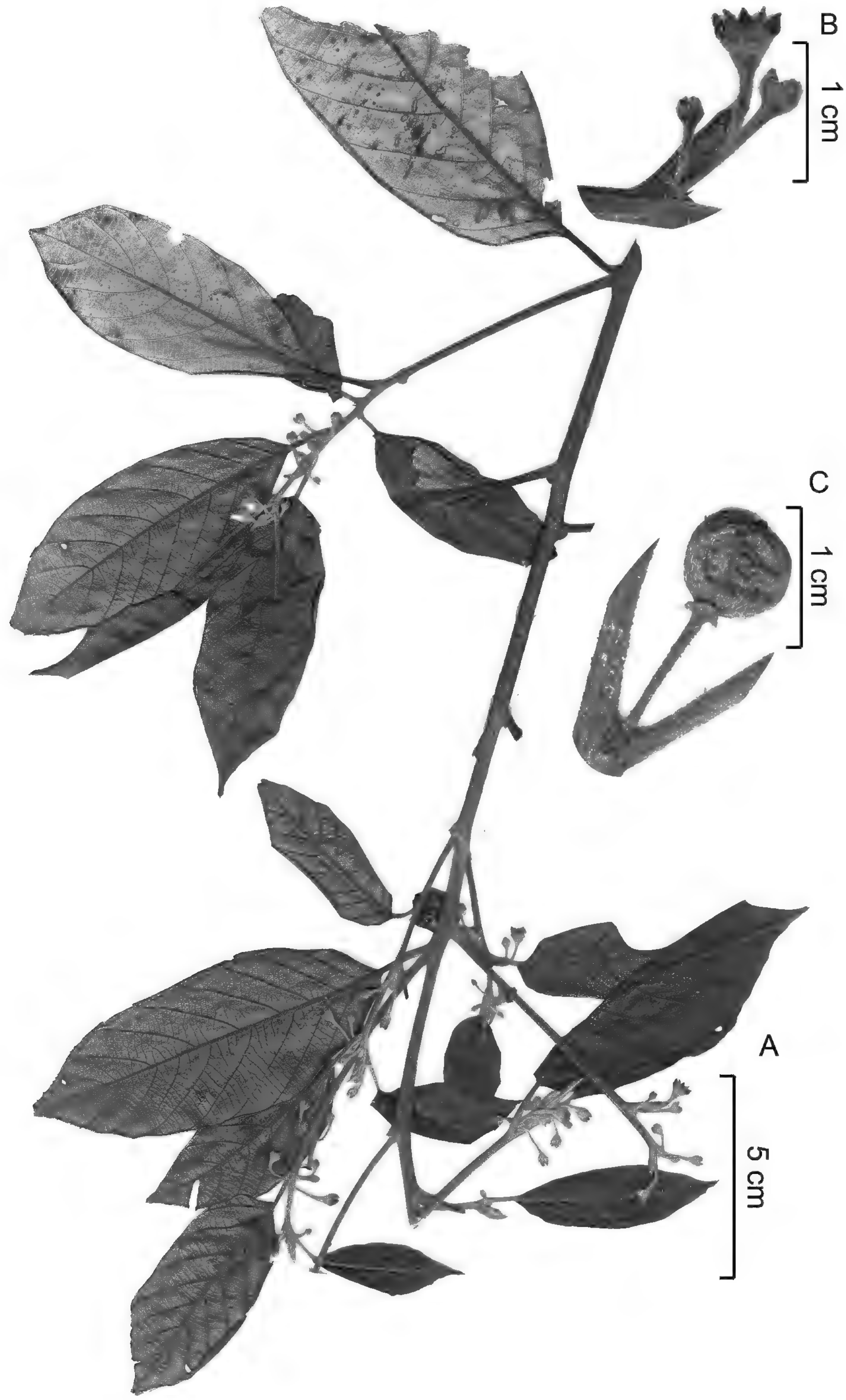

Figure 4. *Frangula grandiflora* A. Pool. —A. Flowering branch. —B. Inflorescence in leaf axil. —C. Immature fruit in leaf axil. A, B taken from the holotype *D. Mejía & T. Hawkins 101* (MO); C from *D. E. Breedlove & B. Bartholomew 55909* (CAS).

mm in flower and in fruit (vs. 10–13 in flower and 12–19 mm, in fruit) and smaller flowers (2–3.5 mm vs. 4–5.75 mm) and campanulate hypanthia (vs. funnelform).

Distribution. This new species is known from only two localities. *Frangula grandiflora* is described from the type location within the Parque Nacional de Celaque, Lempira, Honduras, and is also known from

the Cerro Mozotal, Chiapas, Mexico. It has been collected in cloud forest between 2500 and 2700 m in elevation.

IUCN Red List category. *Frangula grandiflora* is assessed as DD or Data Deficient, according to IUCN (2012) criteria. The new species is known from only three collections from two localities, and the EOO is estimated at 2100 km², AOO at 12 km². Two of the collections were made in protected areas within the Parque Nacional de Celaque in Honduras.

Paratypes. MEXICO. **Chiapas:** Mpio. of Motozintla de Mendoza, near summit of Cerro Mozotal, 24 Nov. 1981, *D. E. Breedlove & B. Bartholomew 55909* (CAS, TEX). HONDURAS. **Lempira:** Río Arcágual, Parque Nac. de Celaque, 14°40′N 88°42′W, 15 May 1992, *T. Hawkins, P. House, B. Allen & R. Moran 78* (EAP not seen, HEH not seen, MO-4598110, MO-4634191, TEFH not seen).

10. Frangula hintonii (M. C. Johnst. & L. A. Johnst.) A. Pool, comb. nov. Basionym: *Rhamnus hintonii* M. C. Johnst. & L. A. Johnst., Fl. Neotrop. 20: 42. 1978. TYPE: Mexico [State of Mexico], Temascaltepec, Rincón, 1960 m, 30 July 1932, *G. B. Hinton 1141* (holotype, K not seen; isotypes ASU not seen, BM not seen, image, DBG not seen).

This species, as described by Johnston and Johnston (1978), is known from west central and central Mexico and can have either glabrous or pubescent ovaries and fruits. The flowers are borne in sessile fascicles on pedicels smaller than the subtending leaf petioles. Its most unusual characteristic is the leaf margins which are conspicuously toothed with the teeth irregular in size and shape.

11. Frangula inconspicua A. Pool, sp. nov. TYPE: Mexico. Oaxaca: Mpio. San Felipe Usila, Parteaguas, ladera con exposición S, 3.5 km en linea recta al SE de Santa Cruz Tepetotutla, 17°42′53″N 96°32′12″W, 1050 m, 7 mayo 1994, *P. Osorio H. 159* (holotype, MO; isotype, MEXU not seen). Figure 5.

Diagnosis. *Frangula inconspicua* A. Pool is similar to *F. mucronata* (Schltdl.) Grubov, differing in the pubescent ovary and fruit, consistently persistent stipules, usually smaller flowers, and membranaceous leaves with the adaxial surface drying a darker color than the abaxial surface.

Shrubs and small trees, 1.5–4 m, young branches abundantly to densely covered with appressed to ascending or slightly spreading, off-white to pale red-gold trichomes. Leaves with blades 5–10.2 × 1.5–3.5 cm, elliptic, membranaceous, adaxial surface dark brown or dark green and abaxial surface light green or light brown, (5)6 or 7(8) pairs of lateral veins, these at 45° angles to midrib, adaxial surface with appressed to ascending trichomes on midrib and lateral veins, abaxial surface with sparse to numerous appressed to ascending trichomes on all orders of venation and sometimes sparsely on surface, sometimes with some additional trichomes laterally spreading from midrib, lamina base cuneate to attenuate, margin flat to slightly recurved with 4 to 6 teeth/centimeter, distinctly serrate with teeth curving away from leaf surface to, more frequently, teeth overlapping adaxial surface, often only the apical gland of teeth apparent, blade apex acuminate, tip often slightly mucronate; all or most stipules consistently persisting into fruiting, 1.5–3.5 mm; petiole 3–10 mm. Inflorescence a solitary flower or pair of flowers, rarely a sessile fascicle of 4 flowers; pedicels 2.2–4 mm, (rarely half) ca. equaling length of subtending petiole, 4–6 mm in fruit, 2/3 to slightly longer than subtending petiole. Flowers 2–2.5 mm, with the hypanthium tubular to campanulate, 1–1.5 × 1.75–2.2 mm, hypanthium width 3/4 to equaling the length of flower with abundant trichomes that are appressed and ascending to slightly spreading, with circumscissile dehiscence, the sepals, petals, and stamens lost early with upper portion of hypanthium; sepals 0.75–1 × 0.75 mm, 2/3 to equaling hypanthium in length, erect; petals ca. 0.75 × 0.75–1 mm, strongly apically bi-lobed, glabrous or with trichomes on midrib, slightly apically exserted; stamens with filaments 0.5–0.6 mm, anthers 0.5–0.6 mm, apically visible free from petals; ovary with dense long trichomes, style 0.5–1 mm, stigma 3-lobed. Young fruits solitary, with scattered trichomes, globose, with 3 inconspicuous vertical lines; all sepals, petals and stamen filaments rapidly lost, hypanthium remnant 0.5–1.25 × 2–3 mm, not angled; pyrenes 3, ca. 5 × 4.5 mm.

Phenology. *Frangula inconspicua* was collected in flower in April and May.

This inconspicuous species is most similar to *Frangula mucronata* from which it differs in its pubescent ovary and fruit, the consistently persistent stipules, the usually smaller flowers (2–2.5 mm long), and membranaceous and somewhat bicolored leaves, with the adaxial surface dark brown or dark green and the abaxial light brown or light green. In *F. mucronata*, the ovary and fruit are glabrous, the stipules are inconsistently persistent, the flowers are larger (2.5–3.5 mm long), and the leaves are firm and usually concolorous, yellow-green to yellow-brown on both surfaces. Most of the specimens have been previously identified as *Rhamnus capreifolia* or *R. capreifolia* var. *grandifolia*. *Frangula inconspicua* is

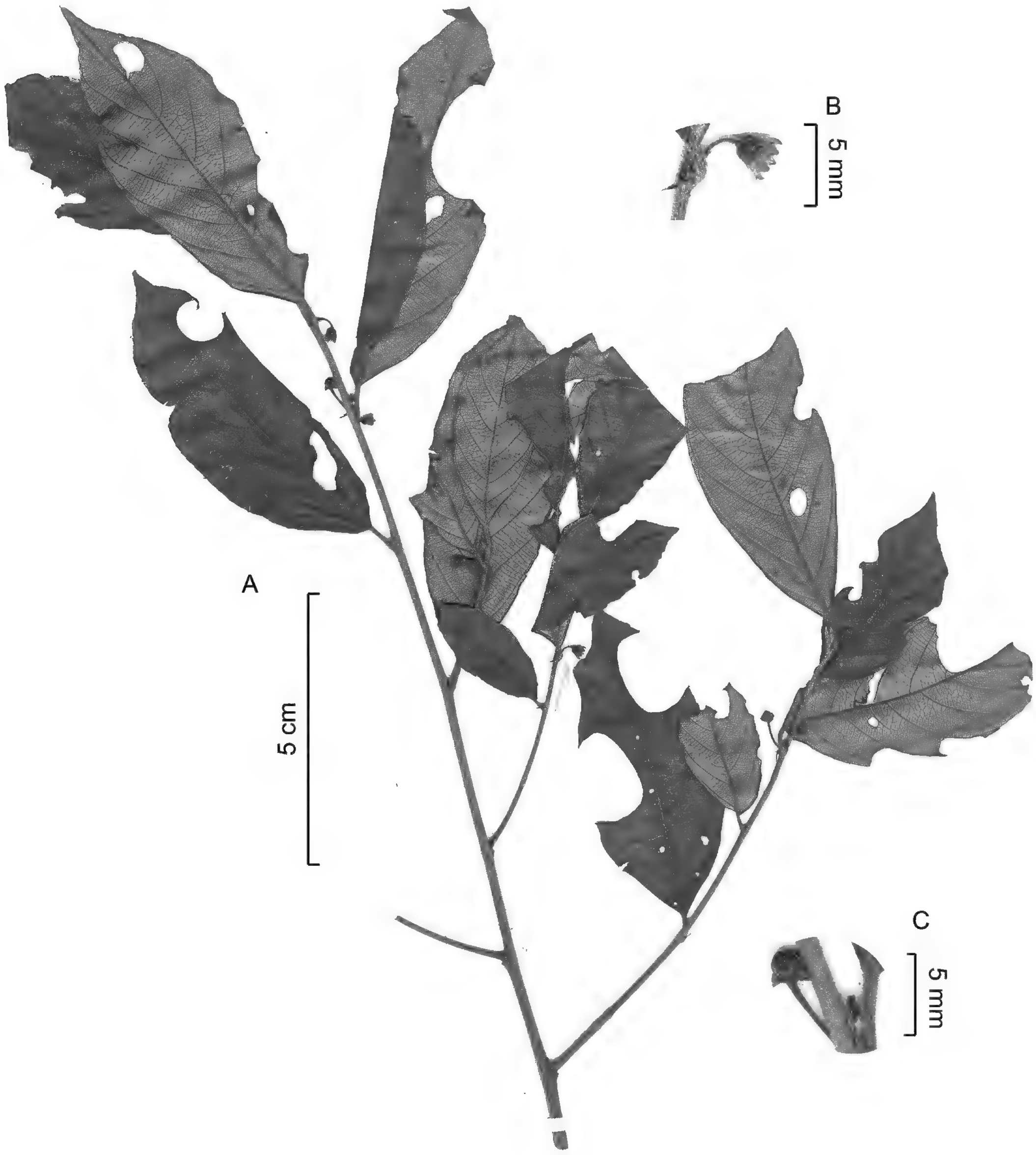

Figure 5. *Frangula inconspicua* A. Pool. —A. Flowering branch. —B. Flower in leaf axil. —C. Immature fruit in leaf axil. A–C taken from the holotype *P. Osorio H. 159* (MO).

similar to *F. capreifolia* var. *grandifolia* in having pubescent ovaries and fruits, but *F. capreifolia* var. *grandifolia* is different in having usually wider leaves (2.8–8.5 cm vs. 1.5–3.5 cm in *F. inconspicua*), with additional pairs of lateral veins (eight to 14 vs. five to eight), rapidly caducous stipules (vs. stipules consistently persistent), the inflorescence often pedunculate (vs. always sessile), flowers in fascicles of six to 20 (vs. flowers solitary or paired, rarely four), flowers with the hypanthium usually wider (2–3.5 mm vs. 1.75–2.2 mm), and sepals spreading to recurved (vs. erect). In fruit, *F. inconspicua* is sometimes confused with *F. longistyla*, which has narrowly elliptic leaves, sporadically retained stipules, and pubescent fruits, one to three per fascicle on pedicels that are often equal to (total range 3/5 to two times) the subtending petiole. However, *F. longistyla* differs from *F. inconspicua* in having lateral veins usually initiating at a wider angle to midrib (rarely 45°, typically 60–80° vs. more consistently 45° in *F. inconspicua*) and tortuous erect trichomes on the venation of the abaxial leaf surface, sometimes very sparse and

limited to midrib (vs. trichomes more or less straight or slightly curved and appressed to ascending). The species are easily separated in flower: *F. longistyla* has flowers 3.5–4.75 mm long (vs. 2–2.5 mm in *F. inconspicua*) with sepals spreading to strongly recurved (vs. erect).

Distribution. The new species has been collected only from Oaxaca, Mexico, with seven of the collections from the municipio San Felipe Usila and one additional collection from Sta. María Chimalapa. *Frangula inconspicua* was collected between 1050 and 1900 m in cloud forest.

IUCN Red List category. *Frangula inconspicua* is assessed as DD or Data Deficient, according to IUCN Red List (2012) criteria. No material of this taxon was received on loan, and, as the MO holdings from Oaxaca are not strong, the EOO and AOO were not calculated.

Paratypes. MEXICO. **Oaxaca:** Juchitán, Sta. María Chimalapa, Puerto de los Duendes, en filo entre Cerro El Quetzal (al NE) y Cerro Salomon (al S), 16°45′30″N 094°11′30″W, 22 July 1985, *T. L. Wendt, M. Ishiki I. & S. Maya J. 5092* (CHAPA not seen, MO); Tuxtepec, Mpio. San Felipe Usila, 7 km S de Santa Cruz Tepetotutla, 17°40′19″N 096°32′31″W, 4 Apr. 1994, *A. Rincón G., C. Gallardo H., S. Espinosa & N. Flores 384* (MEXU not seen, MO), 4.4 km SE de Santa Cruz Tepetotutla, 17°42′10″N 096°32′30″W, 17 Sep. 2004, *A. Rincón G. 3103* (MEXU not seen, MO), 4.8 km SE de Santa Cruz Tepetotutla, 17°41′47″N 096°32′15″W, 23 Nov. 1996, *C. Gallardo H., A. Rincón G., J. Meave del C., F. G. Lorea H. & D. Munn 1958* (MEXU not seen, MO), 5.2 km SE de Santa Cruz Tepetotutla, 17°41′34″N 096°32′07″W, 26 Mar. 1995, *A. Rincón G., C. Gallardo H., E. A. Pérez G., A. Osorio M. & B. Osorio M. 568* (MEXU not seen, MO), 4.5 km SE de Santa Cruz Tepetotutla, 17°42′03″N 096°32′36″W, 27 Nov. 1997, *A. Rincón G., C. Gallardo H., J. Meave del C. & Y. Arellanes C. 818* (MEXU not seen, MO), 24 Nov. 1997, *C. Gallardo H., A. Rincón G., J. Meave del C. & Y. Arellanes C. 2181* (MEXU not seen, MO).

12. Frangula longipedicellata A. Pool, nom. et stat. nov. Replaced name: *Rhamnus sphaerosperma* var. *longipes* M. C. Johnst. & L. A. Johnst., Fl. Neotrop. 20: 62. 1978, non *Frangula longipes* (Merr. & Chun) Grubov, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 8: 266. 1949. TYPE: Puerto Rico, prope Lares in fruticetis ad Jobos, 29 Jan. 1887, *P. Sintenis 6075* (holotype, M not seen; isotypes, BM not seen, image, GH not seen, K not seen, image, L not seen, MO, NY, P not seen, S not seen, image, W not seen, WU not seen).

When transferring this taxon to *Frangula* at species rank, the name *F. longipes* (Merr. & Chun) Grubov blocks the use of the varietal epithet established by Johnston and Johnston (1978).

Johnston and Johnston (1978) published this taxon at the rank of variety within *Rhamnus sphaerosperma*, but it is here recognized at the species rank, based on the many differences between the two taxa. *Frangula longipedicellata* differs from *F. sphaerosperma* in the hypanthium shape and pubescence (tubular and pilose vs. campanulate and with appressed trichomes in *F. sphaerosperma*), the floral size (3–4 mm, hypanthium width 2/3 the length of flower vs. 1.75–3 mm, and hypanthium width equal to length of flower), the petals and anthers only apically exserted versus well-exserted, and pedicel lengths (5.5–9 mm in flower and 8–15 mm in fruit vs. 1.5–3 mm and 1.5–4 mm). The species have non-overlapping geographic distributions, with *F. sphaerosperma* known from Cuba and Jamaica and *F. longipedicellata* from Hispaniola and Puerto Rico (Johnston & Johnston, 1978).

13. Frangula longistyla (C. B. Wolf) A. Pool, comb. nov. Basionym: *Rhamnus longistyla* C. B. Wolf, Rancho Santa Ana Bot. Gard. Monogr., Bot. Ser. 1: 113. 1938. TYPE: Mexico. Hidalgo: pine forests near Trinidad Iron Works, 30 Apr. 1904, *C. G. Pringle 8897* (holotype, US not seen, image; isotypes, BM not seen, image, CAS not seen, image, MA not seen, image, MO, RSA not seen, image, UC not seen).

This species is easily recognized in flower due to its large flowers (3.5–4.75 mm) with tubular hypanthia and sepals spreading to strongly recurved. In fruit it can be confused with *Frangula grandiflora* and *F. inconspicua* (cf. discussion for *F. grandiflora* and *F. inconspicua*).

14. Frangula marahuacensis (Steyerm. & Maguire) A. Pool, comb. nov. Basionym: *Rhamnus marahuacensis* Steyerm. & Maguire, Acta Bot. Venez. 14 (3): 22. 1984. TYPE: Venezuela. Amazonas: Depto. Atabapo, Cerro Marahuaca, (Fhuif), cumbre, zona arbolada en la altiplanicie, río arriba, 3°35′ N 65°20′O, 2480–2500 m, 2 Feb. 1982, *J. A. Steyermark, M. Guariglia, N. Holmgren, J. Luteyn & S. Mori 126049* (holotype, VEN not seen, image; isotypes, F not seen, image, NY not seen, image, US not seen, image).

Rhamnus sipapoensis Steyerm., Ann. Missouri Bot. Gard. 75: 1066. 1988, syn. nov. TYPE: Venezuela. Amazonas: Cerro Sipapo (Paráque), rim head of South Basin, occasional in woodland, rugged terrain, 1970 m, 26–28 Jan. 1949, *B. Maguire & L. Politi 28656* (holotype, NY not seen, image; isotypes, COL not

seen, image, K not seen, image, MO, US not seen, image).

In the protologue of *Rhamnus sipapoensis*, Steyermark distinguished his new species from *R. marahuacensis* by its inflorescences being epedunculate to peduncle 6 mm (peduncle 10–25 mm in protologue of *R. marahuacensis*) and by the densely tomentose calyx, pedicels, and stems, "the mainly entire leaf margins; the obtusely acute to abruptly short-acute, mucronate leaf blades" (Steyermark, 1988: 1067) (leaf margins obscurely crenulate and apices rounded-apiculate in protologue of *R. marahuacensis*), and the more densely tomentose abaxial leaf surfaces. Specimens examined found these characters inconsistent, with isotypes of both *R. sipapoensis* (MO) and *R. marahuacensis* (NY) each having some leaves with apices rounded-apiculate and some with apices abruptly short-acute and mucronate. An additional specimen (*O. Huber & L. Izquiero 12825* [MO]) has the rounded-apiculate leaves associated with *R. marahuacensis* and the short peduncle (ca. 2 mm) associated with *R. sipapoensis*. No other differences were found to recognize the two as independent species. Therefore, only *R. marahuacensis* is transferred to *Frangula*, and *R. sipapoensis* is treated as its synonym. Known from the Guayana region of Venezuela, *F. marahuacensis* would be identified, using the key of Johnston and Johnston (1978: 10), as *R. goudotiana*. *Frangula marahuacensis* differs from this taxon most notably in its pubescent ovaries and fruits, often pedunculate inflorescences and infructescences, and the circumscissile hypanthium, contrasting in *F. goudotiana*, its glabrous ovaries and fruits, sessile fascicles of flowers and fruits, and the hypanthium not circumscissile (cf. discussion for *F. chimantensis*).

15. Frangula mcvaughii (L. A. Johnst. & M. C. Johnst.) A. Pool, comb. nov. Basionym: *Rhamnus mcvaughii* L. A. Johnst. & M. C. Johnst., Fl. Neotrop. 20: 50. 1978. TYPE: Mexico. Oaxaca: Sierra de Juárez, Tuxtepec, ca. 50 mi. N of Oaxaca City and 17 mi. S of northernmost high pass, 2800 m, 12 Oct. 1962, *R. McVaugh 21827* (holotype, MICH).

Frangula mcvaughii is similar to *F. pringlei* and *F. wendtii* (Ishiki) A. Pool in having persistent stipules, pedicels long relative to the petioles of the subtending leaves (in *F. mcvaughii*, pedicels 3–5 times the length of the petiole in flower and 4–7 times in fruit) and glabrous ovaries and fruits. It differs from both these species in having leaves with eight to 10 pairs of lateral veins, the lateral veins barely distinguishable from the tertiary veins and initiating at 70–90° angles to the midrib, the ultimate tip of the leaves strongly retuse with the midrib extending as a mucro, and the flowers solitary in the leaf axil versus in *F. pringlei* and *F. wendtii* the leaves with four to seven pairs of lateral veins, the lateral veins easily distinguished from the tertiary veins and initiating at 30–45° angles to the midrib, the ultimate tip of the leaves not retuse, and the flowers in fascicles of one to three (or rarely four) per leaf axil.

16. Frangula neblinensis (Maguire & Steyerm.) A. Pool, comb. nov. Basionym: *Rhamnus neblinensis* Maguire & Steyerm., Mem. New York Bot. Gard. 51: 119. 1989. TYPE: Venezuela. Amazonas: Cerro de la Neblina, summit, near Cumbre Camp, 1800 m, 4 Jan. 1954, *B. Maguire, J. J. Wurdack & G. Bunting 37040* (holotype, NY not seen, image; isotypes, MO, VEN not seen, image).

Rhamnus psilocarpa Maguire & Steyerm., Mem. New York Bot. Gard. 51: 119. 1989, syn. nov. TYPE: Venezuela. Amazonas: Cerro de la Neblina, summit, W escarpment, 1–3 km N of Cumbre Camp, 1700 m, 10 Jan. 1954, *B. Maguire, J. J. Wurdack & G. Bunting 37230* (holotype, NY not seen, image; isotypes, MO, VEN not seen, image).

Rhamnus neblinensis Maguire & Steyerm. and *R. psilocarpa* Maguire & Steyerm. were differentiated (Maguire & Steyermark, 1989; Steyermark & Berry, 2004) by differences in leaf shape and venation; *R. neblinensis* with obovate leaves with rounded apices and cuneate bases and the tertiary venation of the abaxial blade surface elevated and *R. psilocarpa* with oblong or ovate-elliptic leaves with sub-acuminate apices and obtuse bases and the tertiary venation of the abaxial blade surface inconspicuous. However, individual leaves observed on the NY holotype and VEN isotype of *R. psilocarpa* have the leaf shape, apex, and base as described for *R. neblinensis* and some specimens (*M. Nee 30680*, MO, and *N. T. Silva & U. Brazão 60924*, MO) have most of the leaves exhibiting the leaf shape described for *R. psilocarpa* but the conspicuous elevated tertiary venation of *R. neblinensis*. No differences could be found to convincingly differentiate these two names, and *R. psilocarpa* is therefore placed in synonymy under *F. neblinensis*. *Frangula neblinensis* is most similar to *F. acuminata* (cf. discussion for *F. acuminata*).

17. Frangula oreodendron (L. O. Williams) A. Pool, comb. nov. Basionym: *Rhamnus oreodendron* L. O. Williams, Fieldiana, Bot. 29: 547. 1963. TYPE: Costa Rica. San José: along Pan American Hwy. betw. Km. 18 & 20 from El Empalme to Villa Mills, 2700 m, 7 July 1960,

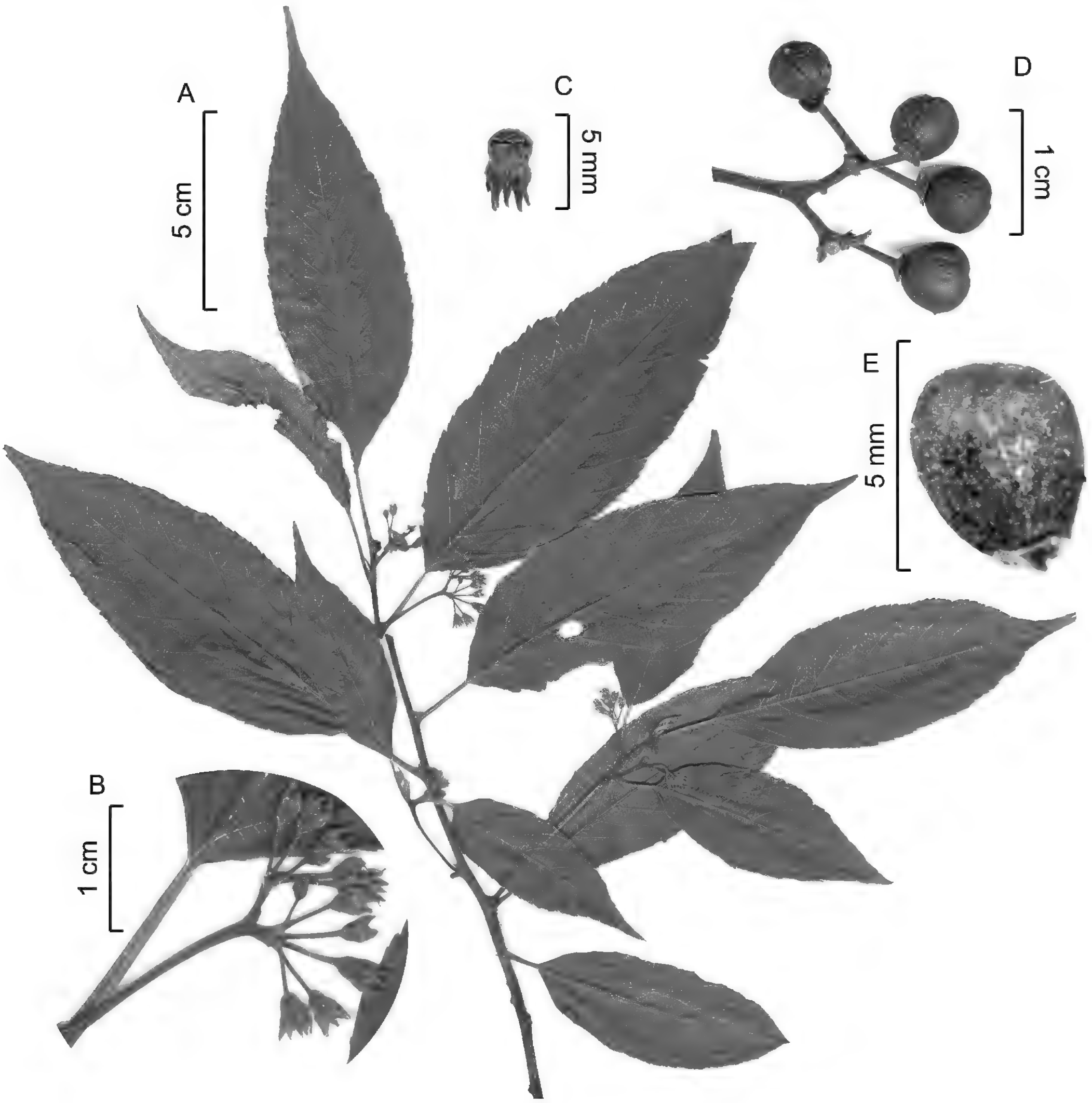

Figure 6. *Frangula pendula* A. Pool. —A. Flowering branch. —B. Inflorescence in leaf axil. —C. Developing fruit with circumscissile hypanthium. —D. Infructescence. —E. Young pyrene with seed exserted at base. A, B taken from the holotype *R. W. Lent 1713* (MO); C from *R. E. Woodson, Jr. & R. W. Schery 492* (GH); D from *W. Haber 644* (MO); E from *J. D. Dwyer 6972* (MO).

M. Cruz 186 (holotype, F; isotype, FLAS not seen).

Frangula oreodendron is one of a few species within the genus distinguished by a non-circumscissile hypanthium (cf. discussion for *F. breedlovei*).

18. Frangula pendula A. Pool, sp. nov. TYPE: Costa Rica. Heredia-Alajuela: Santa Barbara, remnant woods near Quebrada Las Conejas, Concordia, 1800 m, 5 June 1969, *R. W. Lent 1713* (holotype, MO; isotypes, F, NY, US). Figure 6.

Diagnosis. *Frangula pendula* A. Pool is similar to *F. polymorpha* Reissek, differing in the hypanthium tubular, and inflorescences usually strongly divaricate compound cymes and always pedunculate with the pedicels only to 1/3 (rarely to 1/2) the length of the peduncle in flower and to 1/2 the length of the peduncle in fruit.

Small to large trees or shrubs, 2–10 m (occasionally 20–30 m); young branches abundantly to sparsely tomentose or pilose or with appressed and ascending trichomes, trichomes off-white or pale gold. Leaves with blades 6–15 × 2.4–6.3 cm, elliptic, membranaceous, unicolored, with 7 to 12 pairs of lateral veins, lateral veins at 30–60° angles to midrib,

adaxial blade surface with abundant to sparse appressed and ascending trichomes on surface and venation or the indument just on midrib and lateral veins, rarely trichomes tufted in pairs, abaxial blade surface with numerous appressed and ascending to spreading trichomes on all ranks of venation to trichomes sparse on midrib and lateral veins, sometimes trichomes in tufts of 2 or 3, rarely macroscopically conspicuously concentrated along sides of midrib and/or in angles of lateral veins, blade base cuneate or rounded, margin flat or recurved, serrulate, serrate or sometimes only the apical glands apparent, with 3 to 9 teeth/centimeter, apex acuminate or obtuse then cuspidate, sometimes falcate, tip often mucronate; stipules early caducous, 2.5–4 mm; petiole 9–20 mm. Inflorescence a pedunculate and usually divaricate compound cyme, each ultimate group with 2 to 22 flowers, primary peduncles 6–25 mm, (–0.5)0.7–1.7 times length of subtending petiole (length and relative lengths similar in fruit); pedicels 2–5 mm in flower, 1/8–1/3(–1/2) the length of peduncle, 1/8–1/4(–1/2) the length of subtending petiole (2–7 mm long in fruit, 1/7–1/2 the length of peduncle, 1/6–1/3(–1/2) the length of subtending petiole). Flowers 2.75–4(4.5) mm, with the hypanthium tubular, 1.5–2.3 × 1.75–2.8 mm, hypanthium width 1/2–3/4(4/5) of the length of flower with few to numerous, appressed and ascending to spreading trichomes, with circumscissile dehiscence, the sepals, petals, and stamens lost early with upper portion of hypanthium; sepals 1–2.1 × 0.75–1.4 mm, 1/2 to slightly longer than hypanthium in length, erect; petals 0.7–1.2 mm long and wide, broadly or deeply apically bi-lobed, glabrous or with a few trichomes abaxially on midrib, slightly exserted; stamens with filaments 0.5–0.8 mm, anthers 0.4–0.6 mm, infrequently visible free from petals; ovary glabrous, style (0.5)0.9–1.3 mm, stigma 3-lobed. Young fruits 1 to 4 in ultimate groups, glabrous, globose, 3 lines not observable to conspicuous; all sepals, petals, and stamen filaments rapidly lost, hypanthium remnant 0.5–1 × 2–3 mm, not angled; pyrenes 3, ca. 5 × 4.5 mm.

Phenology. *Frangula pendula* was collected in flower between April and July.

Frangula pendula was treated in the *Flora of Panama* (Nowicke, 1971; illustration in Nowicke, 1971: 269, tab. 1) as *Rhamnus pubescens* (Ruiz & Pav.) Triana & Planch. (a later homonym of *R. pubescens* Poir. and treated herein as *F. pubescens*). The latter name, and the species recognized here as *F. pendula*, were both encompassed in Johnston and Johnston (1978) as part of their extremely variable *R. sphaerosperma* var. *pubescens*, which Johnston (1984) referred to *R. sphaerosperma* var. *polymorpha* (cf. discussion for *F. polymorpha*). *Frangula pendula*, with its pedunculate compound inflorescences and glabrous ovaries, is most similar to *F. polymorpha*. *Frangula polymorpha*, endemic to Brazil and Paraguay, differs from *F. pendula* in the hypanthium being funnelform (vs. tubular in *F. pendula*), the petals being strongly exserted with often the whole limb and upper part of the claw exserted and the anthers often free above the petals (vs. only apex of petals exserted and anthers rarely visible above petals), the inflorescences being sometimes sessile, often not compound, divaricate or not (vs. always pedunculate and usually strongly divaricate-compound), and the pedicel in flower 1/3–2 times the peduncle and in fruit 1/2–5 times the peduncle (vs. 1/8–1/3[1/2] in flower and 1/7–1/2 in fruit). Another similar species (and also included in Johnston & Johnston [1978], as *R. sphaerosperma* var. *pubescens*) is the Andean species *F. pubescens*. It differs from *F. pendula* most markedly in its pubescent ovaries and fruits (vs. glabrous in *F. pendula*), subcoriaceous leaves (vs. membranaceous) and variable inflorescences (sessile fascicles, pedunculate simple cymes and compound cymes vs. always pedunculate and usually divaricate compound cymes). Known from Jamaica and Cuba, *F. sphaerosperma* differs from *F. pendula* in its persistent stipules (vs. caducous in *F. pendula*), the hypanthium campanulate (vs. tubular) and flowers 1.75–3 mm long, and approximately equal to the width of the hypanthium (vs. 2.75–4.5 mm and 1.25–2 times the hypanthial width). Occurring in Puerto Rico and Hispaniola, *F. longipedicellata* is similar to *F. pendula* in flower shape and size but always has long pedicels (5.5–9 mm in flower and 8–15 mm in fruit vs. 2–5 mm in flower and 2–7 mm in fruit in *F. pendula*). The pedicels in *F. longipedicellata* are longer than, or rarely in fruit equivalent to, the peduncle length (the peduncle 1–2(4) mm in flower and 1–2(10) mm in fruit, or absent) versus, in *F. pendula*, 1/8–1/2 the peduncle length (the peduncle 6–25 mm).

Distribution. The new species is known from northwestern Costa Rica to northern Panama, where it has been collected commonly between 1100 and 2200 m in montane wet forest. *Frangula pendula* has been rarely collected at lower elevations, between 500 m and 1100 m.

IUCN Red List category. *Frangula pendula* is Data Deficient (DD), according to IUCN (2012) criteria. It is distributed from northwestern Costa Rica to northern Panama. I have seen 75 collections made between 500 and 2200 m in elevation. Its EOO

is ca. 12,600 km² and the AOO is 212 km². Forty-five percent of the known paratype collections were made in protected areas.

Paratypes. COSTA RICA. **Alajuela:** Zarcero, Cerro Palmira, Naranjo, 28 June 1941, *A. Smith 2829* (F). **Cartago:** Empalme, 14 July 1962, *C. A. Brown 17391* (F); Santa María de Dota, 14 July 1962, *C. A. Brown 17390* (F); Carpintera, Hac. Polini, 7 June 1911, *H. Pittier 3667* (F, GH, NY, US); Cartago, Finca Banderilla, San Nicolás, 5 km N del Puente Negro, 9°54′5″N 83°54′41″W, 18 Sep. 1991, *Á. Fernández 142* (CAS, INB not seen, MO); Lankester Gardens, 17 July 1971, *R. W. Lent 2010* (F, MO, NY); Paraiso, Las Concavas, Aug. 1919, *C. H. Lankester K302* (F); Turrialba, terrenos del Instituto, 24 June 1949, *J. León 1651* (US). **Guanacaste:** Liberia, P. N. Rincón de la Vieja, Cordillera de Guanacaste, 10°47′30″N 85°21′15″W, 18 Sep. 1994, *K. Taylor 226* (INB not seen, MO). **Heredia:** rd. N of Gethsemini de Heredia, 19 May 1973, *G. S. Hartshorn 1204* (F, MO), *1205* (F, MO). **Puntarenas:** Cantón de Buenos Aires Sabanas de Murur-Bisuk, cabeceras del Río Ceibo, 9°19′48″N 83°16′48″W, 27 Sep. 1989, *A. Chacón 443* (CR not seen, MO); Parque Nac. Amistad, Las Tablas, near Río Cotón, 8°57′N 82°47′W, 16 July 1982, *C. A. Todzia, L. Diego Gómez P. & R. W. Pohl 1925* (NY, TEX); foothills, Cordillera de Talamanca, valley of Río Cotón betw. Sitio Cotón [Cotonsito] & Sitio Tablas, 8°57′N 82°46′W, 2 Sep. 1983, *G. Davidse 24433* (MO); Fila El Tigre, SE of Las Alturas, 8°56′N 82°51′W, 29 Aug. 1983, *G. Davidse 24180* (MO); 7.5 km NE of Sabalito, 8°51′N 82°53′W, 7 July 1977, *G. L. Webster 21877* (F, TEX); Coto Brus, cuenca Térraba-Sierpe, hac. La Amistad, Zona Protectora Las Tablas, 27 Mar. 2002, *R. Kriebel 6* (MO); Parque Internac. La Amistad, San Vito Coto Brus, Finca Cafrosa, 8°54′00″N 82°46′48″W, 4 July 1990, *R. Delgado 33* (INB not seen, MO); Monteverde, 2 July 1980, *W. A. Haber 389* (MO), 13 Oct. 1984, *W. A. Haber 644* (MO, NY), 9 Sep. 1988, *W. A. Haber 8721* (CR not seen, MO); Buenos Aires, cuenca Térraba-Sierpe, Est. Tres Colinas, Finca Victor Arias, 9°06′40″N 83°04′08″W, 12 Sep. 1996, *E. Alfaro 813* (INB not seen, MO); headwaters of Quebrada Dorora, ca. 9 km NE of Ujarrás, Cordillera de Talamanca, 9°17′24″N 83°15′36″W, 11 Mar. 1993, *M. H. Grayum 10260* (INB not seen, MO); Reserva Indigena Ujarrás, Cordillera de Talamanca, Reserva Biol. Durika, 9°16′30″N 83°14′40″W, 6 Sep. 1995, *R. Aguilar, Q. Jiménez M. & Curso Botánica Amistad 4331* (INB not seen, MO); Coto Brus, Zona Protectora Las Tablas, cuenca Térraba-Sierpe, camino a Las Tablas, 8°55′29″N 82°47′47″W, 28 May 1998, *B. Gamboa R. 2166* (MO); rd. betw. Sitio Tigra & Sitio Las Tablas, near Cerro Chivo, S of Cotón river, 17 July 1983, *D. L. Hazlett 5236* (F); Zona Protectora Las Tablas, Cordillera de Talamanca, Finca Cafrosa, en el tajo, 8°55′15″N 82°47′20″W, 21 June 1996, *E. Navarro V. 365* (INB not seen, MO, NY). **San José:** El Tablago, 8 June 1941, *J. León 818* (F); Zona Protectora Cerros de Escazú, cuenca del río Tarbaca, 9°49′12″N 84°06′00″W, 15 July 1991, *J. F. Morales 37* (MO); Acosta, Fila Bustamante, Cerro Caraigres, 9°43′48″N 84°11′24″W, 22 Apr. 1995, *J. F. Morales & V. Ureña 3998* (CR not seen, MEXU, MO); Alajuelita, near base of Montaña de Cruz SW of Escazú, 9 June 1972, *D. E. Stone 3344* (DUKE not seen, MO); Aserri, alrededores de Barrio Las Mercedes, 9°51′30″N 84°06′00″W, 28 Apr. 1998, *Ó. Valverde 848* (F); Desamparados, vic. of Altos Tablazo ca. 7 km W of Tablón & SE of Higuito, 2 July 1977, *F. Almeda, R. L. Wilbur & T. F. Daniel 2838* (CAS, TEX); Altos Tablazo, ca. 10 km W of Tablón & SE of Higuito, 2 July 1977, *R. L. Wilbur, F. Almeda & T. F. Daniel 21765* (CAS, F, MO, NY); 5 km N de Santa María de Dota, carr. a El Empalme, 9°40′48″N 83°58′12″W, 14 July 1993, *E. Lépiz et al. 35* (CAS, CR not seen, MO); ca. 7.4 km rd. W of Santa María de Dota, 28 Aug. 1968, *R. L. Wilbur & D. E. Stone 10516* (DUKE not seen, MO); Escasú, Cerro de Protti, 31 Aug. 1835, *F. Solís R. 305* (F, MO); Tarrazu, San Marcos, ladera SE del Cerro San Pedro, 9°41′05″N 83°59′48″W, 28 Sep. 2000, *J. Sánchez G., A. Cascante & A. Estrada 999* (CR not seen, F, MO). PANAMA. **Chiriquí:** 13–22 mi. NW of Volcán near Costa Rica border, 13 Sep. 1972, *A. H. Gentry 6026* (MO); Finca en Jaramillo Abajo, 24 Apr. 1986, *A. Taymes s.n.* (MO); Cerro Punta region, Alto los Guerra rd. W of Bambito, 8°53′N 82°37′W, 13 July 1983, *C. W. Hamilton & K. Krager 3889* (MO); Hartman finca, near Cerro Pando, 8°52′N 82°45′W, 22 Aug. 1982, *C. W. Hamilton, H. Stockwell & A. Aiello 807* (MO), *813* (MO); 3 mi. N of El Volcán, 26 June 1969, *E. L. Tyson 5722* (MO), *5725* (MO); Km. 7 on Volcancito rd. W of Boquete, 14 May 1971, *G. R. Proctor 31885* (LL, MO); above Los Llanos, 8°47′N 82°38′W, 3 June 1986, *G. McPherson 9256* (MO); along rd. to top of Volcán Baru, 8°45′N 82°30′W, 28 July 1987, *G. McPherson 11334* (MO); vic. of Volcán Baru, near lake shore at Los Lagos de Volcán, 8°45′N 82°40′W, 9 June 1986, *G. McPherson 9456* (MO); gully 0.5 mi. NE of Volcán, 8°47′N 82°38′W, 14 June 1971, *G. L. Webster & G. J. Breckon 16565* (LL, MO); 3.2 km along side rd., E 7.2 km from Río Sereno off rd. from Volcán to Río Sereno, 29 June 1977, *J. P. Folsom 4031* (MO); near Costa Rican border, 13 km by rd. S of Río Sereno, Finca Hartman, 8°50′N 82°45′W, 12 May 1991, *N. Hensold 1012* (F, MO, TEX, US); vic. Finca Lerida, S slopes of Quebrada Velo, 25 July 1947, *P. H. Allen 4737* (F, MO); Río Chiriquí Viejo valley, near El Volcán, 31 July 1938, *P. White 204* (F, MO); vic. of Finca Lerida, 7–11 July 1940, *R. E. Woodson, Jr. & R. W. Schery 209* (GH, MO, US); vic. of callejón seco, Volcán de Chiriquí, 17 July 1940, *R. E. Woodson, Jr. & R. W. Schery 492* (GH, MO, US); Reserva Forestal de Fortuna, Sendero Samudio, 8°43′40″N 82°15′51″W, 20 June 2004, *R. Aizprúa & I. Alvarez B4234* (F, MO, PMA not seen, SCZ not seen, US); beside Crawford Apis site, El Mirado, Alto Quiel, 5 July 1984, *R. J. Schmalzel 1952* (MO); above Jaramillo, 30 Apr. 1983, *R. J. Schmalzel 1493* (MO); Parque Nac. la Amistad, 7 May 1993, *R. A. Pérez, S. Aguilar, A. Hernández & R. B. Foster 708* (F); Alto Quiel-Boquete a 4 km de finca La Fortuna, 15 Aug. 1977, *T. Béliz 244* (F, MO, NY, US); along rd. betw. Volcán & Río Sereno, 13.7 mi. W of Volcán, 8°51′N 82°43′W, 17 June 1987, *T. B. Croat 66339* (MO); Boquete, carr. hacia Bajo Mono, 3 Oct. 1992, *E. Hidalgo de Montenegro & E. Montenegro 102* (F); E slope of Volcán de Chiriquí (Barú), WNW of Boquete, 19 Nov. 1975, *G. Davidse & W. G. D'Arcy 10157* (MO, NY); rd. from Alto Boquete to Bajo Volcancito, 8°46′N 82°26′W - 8°46′N 82°27′W, 20 June 1971, *G. L. Webster 16656* (LL, MO); Boquete, 5 Sep. 1967, *J. D. Dwyer 6972* (MO); Cerro Horqueta, 8 Aug. 1967, *J. D. Dwyer & M. V. Hayden 7575* (GH, MICH); Boquete, 29 July 1972, *J. Massola 21* (MEXU, MO); Finca Collins, vic. of Boquete, 24 July 1966, *K. E. Blum & J. D. Dwyer 2540a* (GH, MO); Boquete, 27 June 1938, *M. E. Davidson 804* (A, F, MO, US), 26 June 1938, *M. E. Davidson 1066* (F, MO, US); 4 mi. above Boquete on rd. to Volcán Barú, 18 May 1976, *T. B. Croat 34856* (MO), *34859* (MO); above Boquete on rd. to Cerro Horqueta, 12 Aug. 1974, *T. B. Croat 27038* (MO); Renacimiento,

Jurutungo-Piedra Candela, 8°53′N 82°44′W, 28 Sep. 1996, *C. Galdames, J. E. Aranda B., L. Guillén & B. Araúz 3483* (MO).

19. Frangula polymorpha Reissek in Martius, Fl. Bras. 11(1): 91. 1861. *Frangula polymorpha* α [var.] *glabra* Reissek in Martius, Fl. Bras. 11(1): 91. 1861. *Rhamnus sphaerosperma* var. *polymorpha* (Reissek) M. C. Johnst., Taxon 33: 124. 1984. TYPE: Brazil. "In prov. Minarum," *Claussen s.n.* (lectotype, designated here, W not seen; isolectotype, BR not seen, image).

Reissek (1861) published *Frangula polymorpha* with three varieties, α variety *glabra* Reissek, β variety *pubescens* Reissek, and γ variety *tomentosa* Reissek, and 13 syntypes, all of which were associated with one of the above varietal names. There was no indication as to which of the varieties was to be treated as the typical variety. Johnston and Johnston (1978: 67) considered the α variety of Reissek (1861) to be the typical variety, but did not formally recognize it as such. Here, ambiguity is removed by selecting the only syntype associated by Reissek (1861) with the name *F. polymorpha* α [var.] *glabra*, *Claussen s.n.*, as the lectotype of the species, *F. polymorpha*, and thereby establishing *F. polymorpha* α [var.] *glabra* as the typical variety, to be treated under the autonym *F. polymorpha* var. *polymorpha*.

Johnston and Johnston (1978) treated the species *Frangula polymorpha*, with all three of Reissek's varieties referred to a single variety of *Rhamnus sphaerosperma*, which they called *R. sphaerosperma* var. *pubescens* (Reissek) M. C. Johnst. [= *F. polymorpha* var. *pubescens* Reissek] (Johnston, 1971). Johnston (1984: 124) nomenclaturally corrected this name to *R. sphaerosperma* var. *polymorpha* (Reissek) M. C. Johnst. to comply with the Demoulin rule that establishes the priority of autonyms over names of the same date and rank (Art. 11.6, McNeill et al., 2012). *Frangula sphaerosperma* (*R. sphaerosperma*, endemic to Jamaica and Cuba) differs from *F. polymorpha* in its flowers with campanulate hypanthia and the width of the hypanthium ca. equal to the length of the flowers versus flowers with funnelform hypanthia and width ca. 2/3 of the length of the flower. *Frangula polymorpha*, as treated here, is known from Brazil (Minas Gerais [e.g., *H. S. Irwin et al. 30310*, MO] and Goiás [e.g., *H. S. Irwin et. al 10729*, MO, US] south to Rio Grande do Sul [e.g., *R. Wasum 350*, MO]) and Paraguay (e.g., *I. Basualdo 1702*, MO). Johnston and Johnston (1978) included 25 names in synonymy below *R. sphaerosperma* var. *pubescens*, which they treated from Costa Rica to Argentina, and in South America including the Andes and the mountains of southeastern Brazil. Please see discussion for *F. pendula* and *F. darienensis* with respect to the Central American species and for *F. pubescens* relative to the Andean species. *Frangula chrysophylla* Reissek from southeastern Brazil is also considered distinct here, differing from *F. polymorpha* (and *F. sphaerosperma*) in its pubescent ovaries and fruits, and the abaxial leaf surfaces are densely covered with appressed stellate trichomes. In both *F. polymorpha* and *F. sphaerosperma*, the ovaries and fruits are glabrous and the leaves are without stellate trichomes. *Frangula chrysophylla* overlaps in geographic distribution with *F. polymorpha* in southeastern Brazil. Other names are not dealt with at this time.

20. Frangula pubescens (Ruiz & Pav.) Grubov, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 8: 273. 1949. Basionym: *Ceanothus pubescens* Ruiz & Pav., Fl. Peruv. 3: 6, t. 228, f. b. 1802. *Rhamnus pubescens* (Ruiz & Pav.) Triana & Planch., Ann. Sci. Nat., Bot., sér. 5, 16: 379. 1872, non *Rhamnus pubescens* Poir. in Lam., Encycl. 4: 464. 1798. TYPE: Peru. "In Andium nemoribus vs. Chacahuassi tractus," *H. Ruiz s.n.* (holotype, P not seen; isotypes, BR not seen, image, MA not seen, image).

Rhamnus citrifolia Rusby, Bull. New York Bot. Gard. 4: 340. 1907. Syn. nov. *Frangula citrifolia* (Rusby) Grubov, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 8: 276. 1949. TYPE: Bolivia, s. loc., s.d., *M. Bang 1891* (lectotype, designated here, NY-415036 not seen, image; isolectotypes, BM not seen, image, E not seen, image, F not seen, image, GH not seen, K, not seen, image, M not seen, MICH not seen, image, MO, NY-415037, PH not seen, image, US not seen, image, W not seen, Z not seen).

Only one collection (*Bang 1891*) was cited by Rusby in the protologue of *Rhamnus citrifolia* Rusby. Two specimens of this collection at NY are annotated by Rusby as *R. citrifolia*. The more complete of the two, NY-415036, is selected as the lectotype. Examination of typical material led to the placement of *R. citrifolia* in synonymy of *Frangula pubescens*.

Johnston and Johnston (1978) included both *Frangula pubescens* and *Rhamnus citrifolia* in synonymy of *R. sphaerosperma* var. *pubescens* (Reissek) M. C. Johnst. (treated here as *F. polymorpha*). *Frangula pubescens* from Andean South America differs from *F. polymorpha* in having pubescent ovaries and fruits and flowers with the hypanthia tubular and longer than the sepals versus in *F. polymorpha* (from southeastern Brazil and Paraguay) ovaries and fruits glabrous and flowers with hypanthia funnelform and ca. equal in length to sepals. Probably a number of the other names described from the Andes and included by Johnston and Johnston

(1978) as synonyms of *R. sphaerosperma* var. *pubescens* are actually referable to *F. pubescens*, but more study is needed. *Frangula pubescens* differs from *F. sphaerosperma* in its pubescent ovaries and fruits, caducous stipules, tubular hypanthia, and petals only apically exserted versus glabrous ovaries and fruits, persistent stipules, campanulate hypanthia, and petals well exserted.

21. Frangula riojae (Perkins) Grubov, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 8: 275. 1949, as "rioja." Basionym: *Rhamnus riojae* Perkins, Bot. Jahrb. Syst. 45: 465. 1911. TYPE: Peru. "Loreto" [San Martin?]: Rioja, westlich von Moyobamba, 800–900 m, Savannen Gehölz, Sep. 1904, *A. Weberbauer 4697* (lectotype, designated here, G not seen, photo).

The holotype of *Rhamnus riojae* at B was destroyed, and the isotype at G is here selected as the lectotype.

Johnston and Johnston (1978) treated this taxon as synonymous with *Rhamnus granulosa* (Ruiz & Pav.) Weberb. ex M. C. Johnst. [≡ *Frangula granulosa* (Ruiz & Pav.) Grubov]. Based on the ovary of *F. riojae*, described in the protologue as glabrous, and the tubular and circumscissile hypanthium, depicted in the photo of the lectotype, I suggest that this name be removed from the synonymy of *F. granulosa*, which has a pubescent ovary, and a very broadly campanulate to rotate and non-circumscissile hypanthium. I have not seen actual specimens that correspond with the type and description of *F. riojae*.

22. Frangula scopulorum (M. E. Jones) A. Pool, comb. nov. Basionym: *Rhamnus serrata* var. *scopulorum* M. E. Jones, Contr. W. Bot. 12: 6. 1908. *Rhamnus scopulorum* (M. E. Jones) C. B. Wolf, Rancho Santa Ana Bot. Gard. Monogr., Bot. Ser. 1: 122. 1938. TYPE: Mexico. Chihuahua: near Chuichupa, Sierra Madre Mtns., upper end of Guayanopa Canyon, 5000 ft., 23 Sep. 1903, *M. E. Jones s.n.* (holotype, RSA not seen, image).

Jones (1908) published this taxon as a variety of *Rhamnus serrata* Schult., a member of the genus *Rhamnus*, as recognized here. Wolf (1938) recognized this taxon at the species level in the genus *Rhamnus* subg. *Frangula* (Mill.) Gray. Grubov (1949) kept this name in the genus *Rhamnus*, presumably because he did not see the type which has the pyrenes of the *Frangula* kind, indehiscent with the cartilaginous seed base exserted.

23. Frangula surotatensis (Gentry) A. Pool, comb. nov. Basionym: *Rhamnus surotatensis* Gentry, Brittonia 6: 321. 1948. TYPE: Mexico. Sinaloa: Ocurahui, Sierra Surotato, 1–10 Sep. 1941, *H. S. Gentry 6236* (holotype, MICH not seen, image; isotypes, ASU not seen, GH not seen, MO, NY not seen, image, PH not seen, image).

The type of *Rhamnus surotatensis* Gentry [≡ *Frangula surotatensis* (Gentry) A. Pool] was collected in fruit. It is the only collection of this taxon known from Sinaloa, Mexico, and all of its infructescences are without peduncle. Similar Mexican specimens from Nayarit (in flower, e.g., *F. Flores F. 2106*, MO, and in fruit, e.g., *P. Tenorio L. & G. Flores F. 16341*, MO) and Jalisco (in fruit, e.g., *G. González M. et al. 127*, MO), differ from the type in having pedunculate inflorescences and infructescences, a character that can be variable in other species of *Frangula*, especially when the pedicels are equal to or longer than the peduncles, as is the case in most of these specimens. When specimens with flowers of the non-pedunculate element are known, it may be possible to recognize two separate species. *Frangula surotatensis* in the broad sense (Mexico: Sinaloa, Nayarit, and Jalisco) is most similar to *F. capreifolia* var. *grandifolia* (Mexico: Hidalgo, Veracruz, Puebla, Oaxaca, and Chiapas to Costa Rica). *Frangula surotatensis* differs in having flowers with tubular hypanthia, the hypanthium width to 3/5 of the length of the flower, and the sepals erect. In *F. capreifolia* var. *grandifolia*, the flowers have campanulate hypanthia, the hypanthium width is usually approximately equal to 1.5 times (rarely 2/3) the length of the flower, and the sepals are spreading or recurved.

24. Frangula wendtii (Ishiki) A. Pool, comb. nov. Basionym: *Rhamnus wendtii* Ishiki, Novon 5: 167. 1995. TYPE: Mexico. Oaxaca: Mpio. San Miguel Chimalapa, cima del Cerro Salomón, al NO de la Congregación Benito Juárez, ca. 44 km en línea recta al N de San Pedro Tapanatepec, filo del Cerro con selva baja perennifolia, 16°46′15″N 94°11′45″W, 1830 m, 16 abr. 1986, *M. Ishiki I. 1575* (holotype, MEXU not seen; isotypes, CHAPA not seen, TEX not seen, image).

With its persistent stipules, and the pedicels long relative to the petioles of the subtending leaves (pedicels 1.5–3.5 times length of petiole in flower, 2.5–5 times in fruit), as well as the glabrous ovaries and fruits, this species is most similar to *Frangula mcvaughii* and *F. pringlei*. From *F. mcvaughii*, *F. wendtii* differs most markedly in its leaf apex (acuminate vs. obtuse, truncate or acute in *F.*

mcvaughii) and the lateral veins (four to six pairs at 30–45° angles vs. eight to 10 pairs at 70–90° angles). The pedicels in *F. wendtii* are shorter relative to the petioles than in *F. mcvaughii*; in *F. mcvaughii* the pedicels are three to five times the length of the subtending petiole in flower and four to seven times in fruit. From *F. pringlei*, *F. wendtii* differs in leaf shape as elliptic, with acuminate apex, the blade is glabrescent, with the trichomes restricted to the midrib or to the midrib and lateral veins, and the marginal tooth glands not on stalks. In *F. pringlei*, the leaves are usually obovate, sometimes elliptic, with obtuse to rounded to less frequently acute apices, the blade surfaces are pubescent, usually densely so, and the marginal tooth glands are on filiform stalks. The shape of immature fruit is more or less obovate in *F. wendtii* versus obcordate in *F. pringlei*.

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Nomenclatural Transfers in the Pantropical Genus *Myrsine* (Myrsinaceae)

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Abstract. The names of 14 taxa of *Rapanea* Aubl. are transferred to *Myrsine* L. (Myrsinaceae). The 14 new combinations include: *M. acutiloba* (Mez) Ricketson & Pipoly [≡ *R. acutiloba* Mez]; *M. amischocarpa* (A. C. Sm.) Ricketson & Pipoly [≡ *R. amischocarpa* A. C. Sm.]; *M. boivinii* (Mez) Ricketson & Pipoly [≡ *R. boivinii* Mez]; *M. comorensis* (Mez) Ricketson & Pipoly [≡ *R. comorensis* Mez]; *M. courboniana* (Mez) Ricketson & Pipoly [≡ *R. courboniana* Mez]; *M. crassiramea* (A. C. Sm.) Ricketson & Pipoly [≡ *R. crassiramea* A. C. Sm.]; *M. daphnoides* (Mez) Ricketson & Pipoly [≡ *R. daphnoides* Mez]; *M. forbesii* (Mez) Ricketson & Pipoly [≡ *R. forbesii* Mez]; *M. griffithiana* (Mez) Ricketson & Pipoly [≡ *R. griffithiana* Mez]; *M. hadrocarpa* (A. C. Sm.) Ricketson & Pipoly [≡ *R. hadrocarpa* A. C. Sm.]; *M. longipes* (A. C. Sm.) Ricketson & Pipoly [≡ *R. longipes* A. C. Sm.]; *M. polyantha* (A. C. Sm.) Ricketson & Pipoly [≡ *R. polyantha* A. C. Sm.; *M. seychellarum* (Mez) Ricketson & Pipoly [≡ *R. seychellarum* Mez]; and *M. striata* (Mez) Ricketson & Pipoly [≡ *R. striata* Mez]. Six binomials are lectotypified: *M. boivinii* (Mez) Ricketson & Pipoly; *M. comorensis* (Mez) Ricketson & Pipoly; *M. forbesii* (Mez) Ricketson & Pipoly; *M. griffithiana* (Mez) Ricketson & Pipoly; *M. seychellarum* (Mez) Ricketson & Pipoly; *M. striata* (Mez) Ricketson & Pipoly.

Resumen. Se transfiere 14 especies pertenecientes al género *Rapanea* al género *Myrsine*. Las transferencias están enumeradas en la lista a continuación: *M. acutiloba* (Mez) Ricketson & Pipoly [≡ *R. acutiloba* Mez]; *M. amischocarpa* (A. C. Sm.) Ricketson & Pipoly [≡ *R. amischocarpa* A. C. Sm.]; *M. boivinii* (Mez) Ricketson & Pipoly [≡ *R. boivinii* Mez]; *M. comorensis* (Mez) Ricketson & Pipoly [≡ *R. comorensis* Mez]; *M. courboniana* (Mez) Ricketson & Pipoly [≡ *R. courboniana* Mez]; *M. crassiramea* (A. C. Sm.) Ricketson & Pipoly [≡ *R. crassiramea* A. C. Sm.]; *M. daphnoides* (Mez) Ricketson & Pipoly [≡ *R. daphnoides* Mez]; *M. forbesii* (Mez) Ricketson & Pipoly [≡ *R. forbesii* Mez]; *M. griffithiana* (Mez) Ricketson & Pipoly [≡ *R. griffithiana* Mez]; *M. hadrocarpa* (A.C. Sm.) Ricketson & Pipoly [≡ *R. hadrocarpa* A. C. Sm.]; *M. longipes* (A. C. Sm.) Ricketson & Pipoly [≡ *R. longipes* A. C. Sm.]; *M. polyantha* (A. C. Sm.) Ricketson & Pipoly [≡ *R. polyantha* A. C. Sm.; *M. seychellarum* (Mez) Ricketson & Pipoly [≡ *R. seychellarum* Mez]; y *M. striata* (Mez) Ricketson & Pipoly [≡ *R. striata* Mez]. Se lectotipifican seis binomios: *M. boivinii* (Mez) Ricketson & Pipoly; *M. comorensis* (Mez) Ricketson & Pipoly; *M. forbesii* (Mez) Ricketson & Pipoly; *M. griffithiana* (Mez) Ricketson & Pipoly; *M. seychellarum* (Mez) Ricketson & Pipoly; *M. striata* (Mez) Ricketson & Pipoly.

Key words: Myrsinaceae, *Myrsine*, Philippines, *Rapanea*.

The systematic position and circumscription of the genus *Myrsine* L. (Myrsinaceae) have been discussed in a number of taxonomic works over the last two decades. As summarized regarding transfers into *Myrsine*, Ricketson and Pipoly (2010: 628) stated:

> [t]he relationship among *Myrsine* L. and its satellites (inter alia *Rapanea* Aubl. and *Suttonia* A. Rich.) has been a historical focal point for taxonomic contention that has resulted in the treatment of many species as *Rapanea* by regional floristicians, while monographers have determined that the variation in androecial structure among staminate flowers, and the gynoecial for the pistillate support the concept in the more broadly defined, monophyletic concept of *Myrsine*. Regional monographers recognizing the more inclusive concept include Hosaka (1940), Backer & Bakhuizen van den Brink (1965), Smith (1973), Fosberg & Sachet (1975, 1980), Sachet (1975), Li (1978), Wagner et al. (1990), Pipoly & Chen (1995), Pipoly (1996, 2007), Jackes (2005), Takeuchi and

Pipoly (2009), and Ricketson & Pipoly (1998, 2010). Among all of these papers, the most detailed discussion is provided by Pipoly (1996) in treating *Myrsine* of the Philippines.

After an extensive survey, including detailed examination for each of the remaining entities associated with the genus *Rapanea* Aubl., we have determined that the following names are still orphaned and in need of being transferred into *Myrsine*. Any remaining names in *Rapanea* without a corresponding name in *Myrsine* are considered taxonomic synonyms and are not in need of transfer.

1. **Myrsine acutiloba** (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea acutiloba* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 390. 1902. TYPE: Colombia. Magdalena: Santa Marta Mpio., Sierra Nevada de Santa Marta, Tomarazon bei Rio Hadea, s.d. (fl.), *H. Karsten s.n.* (holotype, W-0030344, F neg. 31984 [W image]; isotype, F [W fragm.]).

Currently, *Myrsine acutiloba* is known only from the type collection from the Sierra Nevada de Santa Marta in Colombia. Images of the W holotype and the F isotype are available from the respective institutions' web sites.

2. **Myrsine amischocarpa** (A. C. Sm.) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea amischocarpa* A. C. Sm., J. Arnold Arbor. 54(2): 280–281. 1973. TYPE: Vanuatu. Taféa: Aneityum Island, Anelgauhat Bay, 60 m, 12 Feb. 1929 (fr.), *S. Kajewski 751* (holotype, A; isotypes, BISH, K, NY, P, US).

A tree 12–25 m tall in the rainforests and mountain slopes of the Vanikoro Islands (Solomon Islands) and from the islands of Erromango, Ambrym, and Aneityum (Vanuatu). Images of all the listed isotypes are available at JSTOR Plant Science.

3. **Myrsine boivinii** (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea boivinii* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 376. 1902. TYPE: Comoros. Mahoré: lisière des bois au pied de Chongui au dessus de Dappani, July 1848 (fr.), *L. Boivin 3268* (lectotype, designated here, G-DEL [barcode] G00359617; isolectotypes, P [2, barcodes P00184211, P00184212]).

Mez's (1902: 376) original description of *Rapanea boivinii*, "Insel Mayotte (*Boivin* n. *3268*. – Herb. Deless., Wien)" indicates the *Boivin 3268* collection as the type, but the collection was listed from two institutions, thus necessitating the need to designate a lectotype. Unfortunately, Dr. Bruno Wallnöfer, Curator of the Vascular Plant Collections at the Naturhistorisches Museum Wien (W), was unable to locate this material in the collection (Wallnöfer, 2012, pers. comm.). However, the type collection is still represented at G [G00359617] and we elect to designate this collection as the lectotype. An image of the lectotype is available from the G online database, and in addition, images of the two P isolectotypes (P00184211, P00184212) are available from the P web site. Finally, there is an *L. Boivin* sheet available at W identified as *R. boivinii*; unfortunately, it is without a number and is therefore eliminated from the selection of the lectotype.

4. **Myrsine comorensis** (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea comorensis* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 375–376. 1902. TYPE: Comoros. Ngazidja: [Grande Comore], sur le volcan (Vouni), May 1850 (fr.), *L. Boivin s.n.* (lectotype, designated here, W; isolectotypes, BM [BM000925363], P [2, barcodes: P00184189, P00184190]).

Mez (1902: 376) designated a number of collections from Berlin and Wien as syntypes for his new species *Rapanea comorensis*: "Comoren: Insel Johanna auf Bergen 1500 m. ü. (*Hildebrandt* n. *1692* [B†]), Groβ Comoro, auf dem Vulkan 1000–2000 m. ü. (*Kersten* [*s.n.*, Exped. v. d. Decken, B†]), ohne Standortsangabe (*Boivin*, *Humblot* n. *326*, *1534*). – Herb. Berlin, Wien." Extant syntypes from the last two collections cited by Mez were found: Comoros, Mahoré [Mayotte], Forêt de Combani, 18 Oct. 1884 (fl.), *L. Humblot 326* [in sched., *1326*] (BM [barcode] BM000925362, K [barcode] K000226049, P [3, barcodes P00184192, P00184193, P00184194]); and Comoros, Ngazidja [Grande Comore], sur le volcan Anjouan, 1886 (fl., fr.), *L. Humblot 534* [in sched., *1534*] (LE, P [2, barcodes P00184195, P00184196], W). Thus, a lectotype needs to be selected from this material. Any material located at the Berlin Herbarium was lost in 1943 (Hiepko, 1987); it is also impossible at this time to determine which of these collections were lost at B. According to Dr. Bruno Wallnöfer, the only collections remaining in the herbarium are the *L. Humblot 534* (*1534*) and *L. Boivin s.n.* collections (Wallnöfer, 2012, pers. comm.). The *Boivin* collection is annotated by Mez, but the *Humblot* collections do not possess such annotation; thus, we elect to designate the *L. Boivin s.n.* at W as the lectotype. Images of the two P [P00184189, P00184190] isolectotypes are available at the P web site.

5. Myrsine courboniana (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea courboniana* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 395. 1902. TYPE: Uruguay. Montevideo: St. Gabriel, 10 May 1854 (fl.), *A. Courbon s.n.* (holotype, P [barcode] P00649879).

Myrsine courboniana is known only from the Montevideo area of Uruguay. It is interesting to note that there are two *A. Courbon* collections of *M. courboniana* at Paris (P), both marked as types. However, Mez (1902: 395) clearly designates the material collected in May as the type when he states "Montevideo: bei St. Gabriel (Courbon). – Blüht im Mai (Herb. Paris)." We can only assume that A. Courbon must have discovered the species in fruit in November 1853 and returned to the same area the next May and recollected the type material, unfortunately just after anthesis.

6. Myrsine crassiramea (A. C. Sm.) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea crassiramea* A. C. Sm., Bull. Torrey Bot. Club 70(5): 547. 1943. TYPE: Fiji Islands. Mba: Viti Levu, Tholo North, Nandarivatu, 900 m, 16 Dec. 1927 (fr.), *J. Gillespie 4374* (holotype, BISH [barcode] BISH1003567).

Myrsine crassiramea is currently known only from the type collection in the Fiji Islands. An image of the type is available at JSTOR Plant Science.

7. Myrsine daphnoides (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea daphnoides* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 357. 1902. TYPE: India. Near Courtallum, Feb. (fl.), *R. Wight 1779* (types, G-BOISS not located, W not located).

According to Mez's (1902: 357) original description of *Rapanea daphnoides*, the *Wight 1779* collection was mixed, "Vorderindien: bei Courtallum (*Wight* n. *1779* e. p.). – Blüht im Februar (Herb. Boiss.-Barbey, Wien)." Unfortunately, the staff at the Conservatoire et Jardin Botaniques de la Ville de Genève (G) were unable to locate the Boiss.-Barbey type (L. Loze, 2012, pers. comm.). In addition, Dr. Bruno Wallnöfer was also unable to locate this material (Wallnöfer, 2012, pers. comm.). At this time we elect to defer our selection of the lectotype until we are able to locate additional duplicates.

8. Myrsine forbesii (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea forbesii* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 362. 1902. TYPE: Indonesia-Sumatra. Mt. Tengamoes, Lampongs, 6900–7100 ft. [2103–2164 m], 1881–1882 (fr.), *H. Forbes 1870* (lectotype, designated here, L [barcode] L0006815; isolectotypes, A [fragm.], GH, LE).

In Mez's (1902: 362) original description of *Rapanea forbesii*, he cited two Forbes collections, both from the Berlin Herbarium "Sumatra: ohne Standorlsangabe (*Forbes* n. *1870*, *1882*. – Herb. Berlin)." Unfortunately both of the Berlin collections were lost in 1943 (Hiepko, 1987). Several duplicates of the *Forbes 1870* and *1882* collections are known from the same locality as cited, at A [fragm.], GH, L, and LE, and are available to choose from for the lectotype. Unfortunately, none of the material from the Harvard University Herbaria (A and GH) has been imaged. It is interesting to note that the fragment packets from Arnold Arboretum Herbarium (A [barcode] 00025638) are both mounted together, likely fragments from Gray Herbarium sheets (GH [barcodes] 00025639; 00025640). Although we have not seen the LE material, Imkhanitskaya (1996: 40) indicates that duplicates of both syntypes are available at LE. Fortunately, both the types at L (*Forbes 1882* L [barcode] L0006814, and *Forbes 1870* L [barcode] L0006815) have been imaged and are available online. Thus, we designate one of these specimens, *Forbes 1870* (L [barcode] L0006815), as the lectotype.

9. Myrsine griffithiana (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea griffithiana* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 360–361. 1902. TYPE: Myanmar. Malacca, s.d. (fl., fr.), *W. Griffith 3543 [A]* (lectotype, designated here, P [barcode] P00466721; isolectotypes, BR, GH, LE).

In Mez's (1902: 360–361) original description of *Rapanea griffithiana*, he cited a mixed Griffith collection represented at several institutions: "Birma: ohne Standorlsangabe (*Griffith* n. *3543* (e. p.). – Herb. Berlin, Brüssel, A. Gray, Paris)." The *Griffith 3543* collection is mixed from what we here designate the above type material pro parte, as "[*A*]" and the remaining material, which we have identified as *Myrsine porteriana* A. DC as *Griffith 3543* [*B*]. From the syntypes identified by Mez, the Berlin (B) material was lost in 1943 (Hiepko, 1987). Images are available of the Paris (P [barcode] P00466721) sheet and the Brussels (BR [barcode] BR0000005232284) sheet. Unfortunately, only data, and no image, are available from the Harvard University Herbaria website. Thus, we here elect to designate the P material as lectotype as clearly representative of this species.

10. Myrsine hadrocarpa (A. C. Sm.) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea hadrocarpa* A. C. Sm., J. Arnold Arbor. 54(2): 290–291. 1973. TYPE: Fiji Islands. Viti Levu: Kambara, 2–7 Mar. 1934 (fr.), *A. Smith 1245* (holotype, BISH; isotypes, GH, K, NY, S, UC, US).

Myrsine hadrocarpa is a small tree to 8 m tall. It is an endemic species known only from the various island forests of the Fiji Islands.

11. Myrsine longipes (A. C. Sm.) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea longipes* A. C. Sm., J. Arnold Arbor. 54(2): 287–288. 1973. TYPE: Samoa. Savai'i: forest above Letui, Tuisivi Range, 1600–1700 m, 26 Sep. 1929 (fr), *E. Christophersen 779* (holotype, BISH; isotypes, K, NY [2], P, UC, US).

Myrsine longipes is a shrub or small tree, 3–5 m tall. It is endemic to the wet montane forests of Samoa.

12. Myrsine polyantha (A. C. Sm.) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea polyantha* A. C. Sm., J. Arnold Arbor. 54(2): 289–290, figs. 84–85. 1973. TYPE: Fiji Islands. Viti Levu: Mba prov., summit ridge of Mt. Tomanivi, Victoria, 4 May 1962, *R. Melville, E. Melville & J. Parham 7059* (holotype, K; isotypes, A, BISH, SUVA).

Myrsine polyantha is a small tree, ca. 4 m tall. It is endemic to the forests of the Fiji Islands.

13. Myrsine seychellarum (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea seychellarum* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 375. 1902. TYPE: Seychelles. Common on mtn. top in Mahe & Silhouette, 1874 (fr.), *J. Horne 442* (lectotype, designated here, K [barcode] K000226047).

In Mez's (1902: 375) original description of *Rapanea seychellarum*, he cited two *J. Horne* collections "Seychellen-Inseln Maho und Pelonette: häufig auf den Gipfeln der Berge (*J. Hooker* [*Horne*] n. *442*, *588*. – Herb. Kew)." Both collections are still present at K, in fact both are mounted on the same sheet. *Horne 588* (K [barcode] K000226048) is sterile material and *Horne 442* (K [barcode] K000226047) is fertile. We therefore designate the *Horne 442* specimen at K as the lectotype. Images of both the K lectotype and syntype are available online.

14. Myrsine striata (Mez) Ricketson & Pipoly, comb. nov. Basionym: *Rapanea striata* Mez, Pflanzenr. (Engler) IV. 236(Heft 9): 357. 1902. TYPE: India. Malabar, Concan, s.d. (fl.), *J. Stocks & J. Law s.n.* (lectotype, designated here, P [barcode] P00467028; isolectotype, GOET [barcode] GOET008184).

In Mez's (1902: 357) original description of *Rapanea striata*, he cited a single collection by J. Stocks and J. Law "Vorderindien: Malabarküste (*Stocks* u. *Law*)" but failed to designate where the type was located. Of the two syntype duplicates known from P and GOET, the P sheet is by far the better material, and we here designate the material at P as the lectotype (image available online). An image is available of the GOET material at JSTOR Plant Science. It should be mentioned that a third sheet, "India. Karnataka: Mysore District, Bababoodim hills, s.d. (fl), *J. Law s.n.* (K [barcode] K000756358—the image is mistakenly labeled as "*Law 191*," and the "191" is not a collection number but an incomplete year from an annotation label), was rejected as a possible syntype. The sheet does not pose an annotation by Mez and this material is from a different region than the type.

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A New Species of *Pavetta* (Rubiaceae) from South Africa

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Abstract. *Pavetta glaucophylla* Retief, S. J. Siebert & A. E. van Wyk, a new species of the Rubiaceae (Ixoroideae) from South Africa, is described and illustrated. A member of *Pavetta* L. subg. *Pavetta*, it has a restricted range and is near endemic to the Sekhukhuneland Centre of Endemism. Hitherto *P. glaucophylla* has mainly been confused with *P. zeyheri* Sond., from which it differs in being a taller plant with larger, blue-green leaves in living condition instead of dark green to gray-green leaves and flowers in which the calyx lobes are 0.5–0.75 mm long and triangular-ovate, and 1.25–2 mm long and not triangular-lanceolate, as in *P. zeyheri*.

Key words: IUCN Red List, *Pavetta*, Rubiaceae, Sekhukhuneland, South Africa.

The rubiaceous genus *Pavetta* L. belongs to subfamily Ixoroideae, tribe Pavetteae, and comprises ca. 400 species from the Old World tropics, excluding Madagascar (Retief & Leistner, 2000; Bridson, 2003). Sub-Saharan Africa is a center of diversity for the genus, with 21 described species known from South Africa, all restricted to the summer rainfall area (Germishuizen et al., 2006). Although not as diverse as it is further north in Africa, *Pavetta* is the largest of the 53 genera of Rubiaceae native to South Africa (Germishuizen et al., 2006). Members of *Pavetta* are trees, shrubs, or dwarf shrubs (geoxylic suffrutices), and the majority are, among others, readily distinguished from most other woody Rubiaceae by the presence of symbiotic bacterial nodules in the leaf blades (Bridson, 2003). The genus is further characterized by stipules partly to completely connate, mostly long-acuminate to awned; terminal, umbellate inflorescences with numerous fragrant, tetramerous flowers with secondary pollen presentation (on style), usually white, contorted corolla lobes, and a style at least twice as long as the corolla (Retief & Leistner, 2000). The calyx limbs of *Pavetta* have four distinct lobes, and the fruit are fleshy, 2-seeded, and indehiscent (Retief & Leistner, 2000). Even though general floral morphology is very similar in *Pavetta*, the calyx is quite variable and provides some of the best criteria for the infrageneric classification of the group (Bremekamp, 1929; Bridson, 2003).

In southern Africa a number of *Pavetta* species with restricted range are known from recognized centers of floristic endemism (van Wyk & Smith, 2001), for example, *P. tshikondeni* N. Hahn from the Soutpansberg Centre of Endemism (Hahn, 1999) and *P. barbertonensis* Bremek. from the Barberton Centre of Endemism (Bremekamp, 1929). In this paper we describe a new species of *Pavetta* near endemic to the Sekhukhuneland Centre of Endemism in northeastern South Africa. In the past, this species often has been included under *P. zeyheri* Sond., but Siebert et al. (2001) and von Breitenbach et al. (2001) first recognized it as an undescribed species in the literature. Subsequently, Schmidt et al. (2002: 642) referred to it as a "large-leaved form" of *P. zeyheri* that "may prove after further research to be a distinct species." Coates Palgrave (2002) also mentions the Sekhukhuneland taxon under *P. zeyheri* but speculates that it is probably conspecific with *P. microlancea* K. Schum., a taxon known only from the type specimen collected at Komatipoort in easternmost Mpumalanga (Bridson, 2003), outside the range of the new species. A possible link between the new species and *P. microlancea* is refuted by Herman (2005), based on the generally smaller habit, 0.3–1 m, of the latter species, and on *P. microlancea* having fewer-flowered (four to six) umbellate inflorescences, as is

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also indicated by Bridson (2003). Herman (2005) suggests that our new species, already collected as early as 1939 (*Mogg 725*, PRE), has been dumped into a taxonomic "waste bin," namely *P. zeyheri*.

Pavetta glaucophylla Retief, S. J. Siebert & A. E. van Wyk, sp. nov. TYPE: South Africa. Mpumalanga: Sekhukhuneland, Thorncliffe Mine, entrance rd., 1 Dec. 1997 (fl., fr.), *J. E. Burrows 6198* (holotype, PRE; isotype, BNRH). Figure 1.

Species nova secundum morphologiam generalem *Pavettae zeyheri* Sond. proxima, sed ab ea habitu robustiore altioreque, foliis majoribus conspicue glaucis (46–)72(–116) × (7–)13(–25) mm et limbo calycis usque ad medium in lobos breviores (0.5–0.75 mm) triangulari-ovatos (non triangulari-lanceolatos) diviso differt.

Erect, deciduous shrub or small tree, (1.5–)2.5(–3.5) m tall; young twigs glabrous; branches thick, robust. Leaves opposite, sometimes appearing fascicled, sessile, glabrous; lamina narrowly elliptic to oblanceolate, (49–)72(–93) × (8–)13(–21) mm, coriaceous, blue-green in living condition, apex acute, base decurrent, margin entire; midrib on lower surface pale and prominent; domatia absent; bacterial nodules dotlike or elliptical, unevenly scattered in lamina; stipules interpetiolar, limb triangular. Inflorescences sub-umbellate, branched, (32–)37(–44) mm wide; primary inflorescence branches 4–6 mm; flowers (14–)17(–21) clustered on short side branches 10–30 mm long; peduncles 6–8 mm; pedicels 3.5–4.5 mm; bracts up to 2 mm, densely white silky-hairy to almost glabrous inside; bracteoles present but inconspicuous. Flowers (14–)17(–21) per inflorescence; calyx 4-lobed, lobes short, triangular-ovate, 0.5–0.75 mm, glabrous, persistent in fruit, never reflexing; corolla 4-lobed, white, tube cylindrical, (10–)13(–15) mm, lobes (15–)19(–23) mm; style slender, distally slightly thickened into an elongated club-shaped pollen presenter, (21–)26(–32) mm; stigmatic surface confined to bidentate apex; stamens 4, arising in corolla mouth; filaments very short; anthers exserted, dorsifixed near the base, linear to oblong, 5–6 mm. Fruit a drupe, spherical, slightly 2-lobed, (5–)6(–8) × (5–)7(–8) mm, black when ripe, with 1 or 2 pyrenes.

Distribution and habitat. *Pavetta glaucophylla* has been collected in the provinces of Mpumalanga and Limpopo in South Africa (Fig. 2) on calcrete, dolerite, dolomite, gabbro norite, magnetite, and, rarely, shale. It is common on stony, rocky soil in open mountain savanna (bushveld), rarely as part of copses of woody vegetation in grassland, and has been recorded from 500 to 1200 m. The species is confined to that part of the Central Bushveld Bioregion associated with the northeastern Great Escarpment of South Africa, specifically the following vegetation units: Sekhukhune Mountain Bushveld, Sekhukhune Plains Bushveld, and Ohrigstad Mountain Bushveld (Mucina & Rutherford, 2006). Biogeographically, it is near endemic to the Sekhukhuneland Centre of Endemism (mainly on ultramafic substrates), where it ranges, usually on dolomite, into the bordering Wolkberg Centre (van Wyk & Smith, 2001).

IUCN Red List category. *Pavetta glaucophylla* is assessed as of Least Concern (LC) according to IUCN Red List criteria (2001) due to the extent of occurrence, area of occupancy, and the existence of more than 30 known populations (Siebert et al., 2002). *Pavetta glaucophylla* is, however, increasingly subjected to habitat degradation as a result of extensive mining activities and urban expansion in the Sekhukhuneland region.

Phenology. Flowers of *Pavetta glaucophylla* were collected in early summer (November and December) and fruits in summer and autumn (January to May).

Etymology. The epithet *glaucophylla* derives from the Greek and refers to the conspicuous blue-green foliage leaves of the species.

Vernacular names. The local Pedi use the leaves of *Pavetta glaucophylla* as a vegetable, and in Northern Sotho (Sepedi) the plant is called *mabudelalelane*, with *budela* meaning "sour," a reference to the watercress-like taste of the leaves (from *Barnard 1446*, PRE). English and Afrikaans vernacular names for the species are Sekhukhune bride's bush and *sekhukhunebruidsbos*, respectively (van Wyk et al., 2011).

Discussion. Older herbarium collections of *Pavetta glaucophylla* are mainly identified as *P. zeyheri*, and, more particularly, the infraspecific entity is sometimes recognized as *P. zeyheri* subsp. *zeyheri* (Herman, 2005). The two species are superficially rather similar owing to resemblances in gross morphology and geographical distribution. Differences between *P. glaucophylla* and *P. zeyheri* include the distinctly blue-green and larger, (49–)72(–93) × (8–)13(–21) mm, leaves of the former, compared to the dull dark-green to gray-green and smaller, (24–)38(–50) × (7–)8(–11) mm, leaves of the latter. In *P. glaucophylla* the calyx limb-tube is divided at midpoint into relatively short (0.5–0.75 mm), trian-

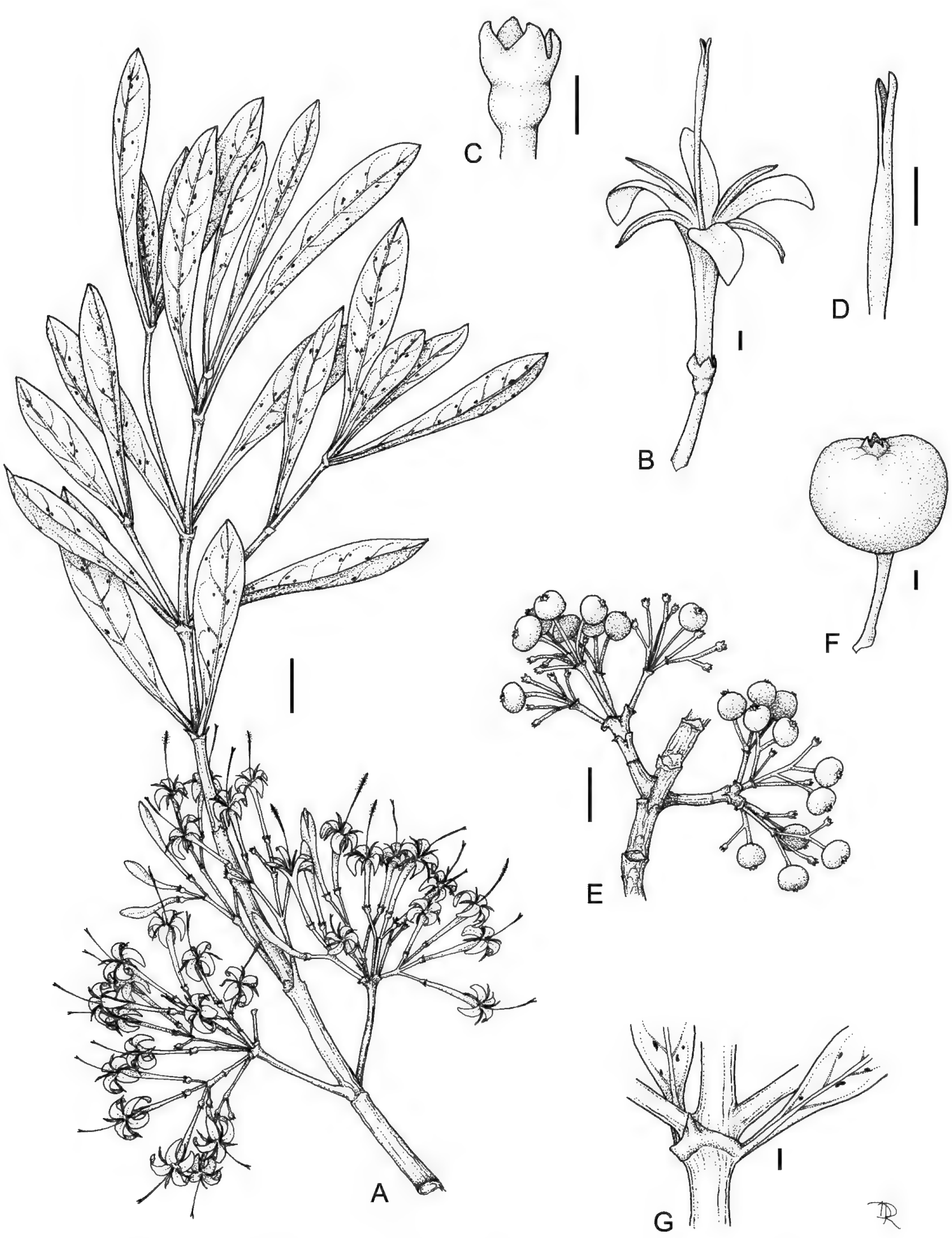

Figure 1. *Pavetta glaucophylla* Retief, S. J. Siebert & A. E. van Wyk. —A. Flowering branch. —B. Flower. —C. Calyx. —D. Pollen presenter with cleft stigma apically. —E. Fruiting branch. —F. Fruit. —G. Stipule. A–D, G drawn from the holotype, *J. E. Burrows 6198* (PRE); E, F from *A. E. van Wyk 12367* (MO). Scale bars: A, E = 10 mm; B–D, F, G = 1 mm.

gular-ovate lobes, but in *P. zeyheri* the calyx limb-tube is shorter than the lobes, with the lobes relatively long (1.25–2 mm) and triangular-lanceolate (for calyx limb types in southern African *Pavetta*, see Bridson, 2003). *Pavetta glaucophylla* is also a more robust and larger plant, (1.5–)2.5(–3.5) m high, with *P. zeyheri* generally slender and smaller, (1–)2(–3) m high.

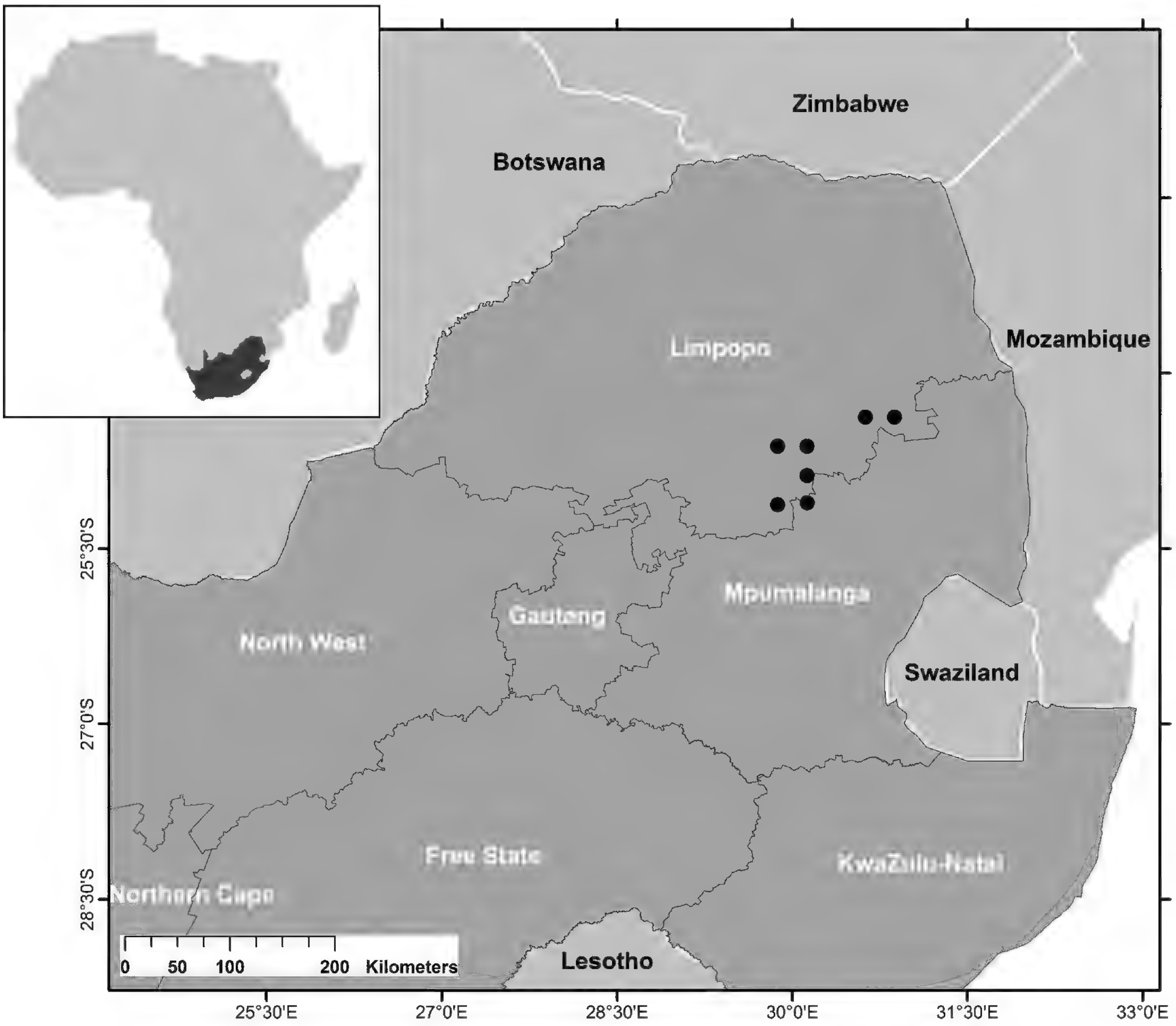

Figure 2. Known geographical distribution of *Pavetta glaucophylla* Retief, S. J. Siebert & A. E. van Wyk in South Africa. Black dots indicate collection localities for the species as vouchered by the type and paratype collections.

To a lesser extent, *Pavetta glaucophylla* was previously also misidentified as *P. inandensis* Bremek. and *P. lanceolata* Eckl. However, these latter two species are easily distinguished by their distinctly petiolate leaves, and the corymbose inflorescences terminal on short branches, never paired, both the inflorescence and its individual parts subtended by leaf pairs (Kok et al., 1987; Bridson, 2003). The leaves of *P. glaucophylla* and *P. zeyheri* are sessile and the sub-umbellate inflorescences terminal on short leafless branches, usually two per node. Moreover, *P. inandensis* and *P. lanceolata* are characterized by stipules with elongated apices up to 3 mm long and domatia on the lower surface of the leaves, whereas *P. glaucophylla* and *P. zeyheri* have broadly triangular stipules and no domatia. *Pavetta lanceolata* further differs from the new species and *P. zeyheri* in having smaller flowers, corolla tube (8–)11(–14) mm long, and smaller fruit, (5–)5.5(–6) × (4–)5(–6) mm. *Pavetta inandensis* also differs in having much larger leaves, (63–)81(–107) × (15–)20(–27) mm, than *P. zeyheri*, and broader inflorescences, (55–)71(–100) mm, than *P. glaucophylla*. *Pavetta zeyheri* has the largest flowers, (10–)14(–18) mm tube length, of all the species considered here.

Paratypes. SOUTH AFRICA. **Limpopo:** Farm Parys, 5 Jan. 1939 (fr.), *A. O. D. Mogg 725* (PRE); Schoonoord, NNW of town, Km. 25, 22 Nov. 1959 (fl.), *J. P. H. Acocks 20941* (PRE); Schoonoord, Nov. 1941, *N. J. van Warmelo 89* (PRE); Farm Zoetvelden, 8 Nov. 1935 (fl.), *W. G. Barnard 144B* (PRE); Penge, circular mine shaft in town, 1 Apr. 1972 (fr.), *J. P. Nel 195* (PRE); Strydom Tunnel, cliff at S entrance, 2 Feb. 1982 (fr.), *A. E. van Wyk, R. Dahlgren & P. D. F. Kok 5474* (PRU), 26 Feb. 1981 (fl.), *A. E. van Wyk 5181* (PRU); Strydom Tunnel, Farm Perkeo, next to old tufa waterfall, 21 Aug. 1985 (fr.), *F. Venter 10860* (PRU). **Mpumalanga:** Roossenekal, Mapoch's Cave rd., Km. 2.5, 14 Nov. 1997 (fl.), *S. J. Siebert 22* (PRE); Thorncliffe, entrance rd. to mine, 17 May 1997 (fr.), *Plant Specialist Group 15* (PRE); Farm Dwarsrivier, 24°55′66″ S, 30°07′22″ E, 17 Nov. 1998 (fl.), *G. B. Deall 4174* (PRU); Roossenekal, rd. to Steelpoort, Km. 14, 13 Apr.

1994 (fr.), *A. E. van Wyk 12367* (MO); Roossenekal, railway station on tar rd. to Steelpoort, Km. 11, 6 Apr. 1994 (fr.), *P. van Wyk BSA2054* (PRU); Farm Dwarsrivier, rd. to Lydenburg, Km. 4, 17 Feb. 1987, *A. E. van Wyk 8015* (MO, PRU); Stofberg, before Mapoch's Mine, Km. 8, 17 Feb. 1987, *A. E. van Wyk 8020* (PRU); Steelpoort, Ferrochrome Holdings, rd. to factory dam, Km. 2, 12 Feb. 1998 (fr.), *S. J. Siebert 297* (PRU); Roossenekal, rd. from Mapoch's Mine to Steelpoort, Km. 4, 11 Apr. 2000 (fr.), *A. E. van Wyk, S. J. Siebert & Y. Steenkamp 1465* (PRU).

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A New Species of *Muellera* (Millettieae, Leguminosae) from Brazil

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Abstract. *Muellera tozziana* M. J. Silva (Millettieae, Leguminosae), a new species endemic to Brazil, is described and illustrated on the basis of field studies during the taxonomic revision of the genus. The species is morphologically similar to *M. denudata* (Benth.) M. Sousa, but it differs and can be characterized by its falcate or oblong-falcate fruits, glabrescent with upper margin discreetly thickened; the pubescent staminal tube and free portion of the filaments and anthers; subtruncate calyx, and delicate leaves.

Resumo. *Muellera tozziana* M. J. Silva (Millettieae, Leguminosae), uma nova espécie endêmica para o Brasil, é descrita e ilustrada baseada em estudos de campo durante a revisão taxonômica do gênero. A espécie é morfologicamente semelhante a *M. denudata* (Benth.) M. Sousa, mas difere e pode ser caracterizada pelos frutos falcados a oblongo-falcados, glabrescentes e levemente espessados na margem superior, tubo estaminal, porção livre dos filetes e anteras pubescentes, cálice subtruncado e folhas delicadas.

Key words: Brazil, IUCN Red List, Leguminosae, Millettieae, *Muerllera*.

Muellera L. f. (Millettieae, Leguminosae) is a Neotropical genus traditionally comprised of the two species *M. monilis* (L.) M. J. Silva & A. M. G. Azevedo and *M. fluvialis* (Lindm.) Burkart that are morphologically similar to members of *Lonchocarpus* Kunth sect. *Laxiflori* (Taub.) Benth. and, therefore, sometimes have been included in that taxon (e.g., Geesink 1981, 1984; Tozzi, 1989, 1992; Fortunato & Palese, 1997). Other authors have treated *Muellera* as a separate genus (e.g., Hermann, 1949, 1965; Burkart, 1969; Polhill, 1981; Schrire, 2005).

Molecular and morphological phylogenetic studies carried out by Silva et al. (2012) on *Lonchocarpus* s.l. showed the paraphyletic origin of the genus, with three main subclades that were morphologically and geographically well defined. One of these subclades, the informally named Muellera subclade, included the two species *L. monilis* (L.) A. M. G. Azevedo and *L. fluvialis* (Lindm.) Fortunato & Palese, which were placed in *Lonchocarpus* sect. *Laxiflori* (Benth.) Taub. by Tozzi (1989), as well as the genera *Margaritolobium* Harms and *Bergeronia* Micheli. Based on such phylogenetic evidence, Silva et al. (2012) re-established the genus *Muellera*, which differs from *Lonchocarpus* by its delicate flowers in pairs along the rachis, the bracteoles being subopposite and located above the middle of the pedicel, the indehiscent fruits with the upper margin not keeled, and the free portion of the staminal tube and anthers being usually pubescent. In *Lonchocarpus*, the flowers are not delicate; the pseudoraceme has a pair of pedicelled flowers on the top of a short branch, similar to the letter Y; the bracteoles are opposite and allocated on the base of the calyx or in the middle of the pedicel; the fruits are usually keeled along the upper margin; and the staminal tube and anthers are commonly glabrous. *Muellera* as now recircumscribed includes 26 species and is mainly South American (Silva, pers. obs.). During the taxonomic revision of *Muellera* by Silva (2010), additional species were discovered, one of which is described and illustrated herein.

Muellera tozziana M. J. Silva, sp. nov. TYPE: Brazil. Pará: Tucuruí, Breu Branco, igapó às margens do Rio Tocantins, 10 Sep. 1983 (fl.), *F. E. Miranda, J. Ramos, E. Lima & A. Silva 538* (holotype, INPA; isotypes, NY, NY photo). Figure 1.

Species nova *Muellerae denudatae* (Benth.) M. Sousa similis, sed ab ea legumine falcato vel oblongo-falcato glabrescente, calyce campanulato subtruncato et tubo staminali filamentis necnon antheris pubescentibus differt.

Shrub or slender treelets, 1.5–6 m tall, branches terete, light to dark brown when mature, glabrous, with small lenticels when young, sparsely puberulent or glabrescent. Leaves 7-foliolate, rarely 5- to 9-foliolate; pulvinus 1–1.2 mm; petiole 1–2.1 cm, rachis 2.5–4.5 cm, both subquadrangular, conspicuously canaliculate above, delicate, striate longitudinally, glabrescent; petiolule 1.7–2 mm, transversally rugose, glabrescent, trichomes hyaline; stipules caducous; leaflets 2.5–5.4 × 1.8–2.6 cm, opposite to subopposite in first and second pairs, predominantly orbicular to rounded, rarely ovate-elliptic or elliptic, base oblique to cuneate, apex predominantly

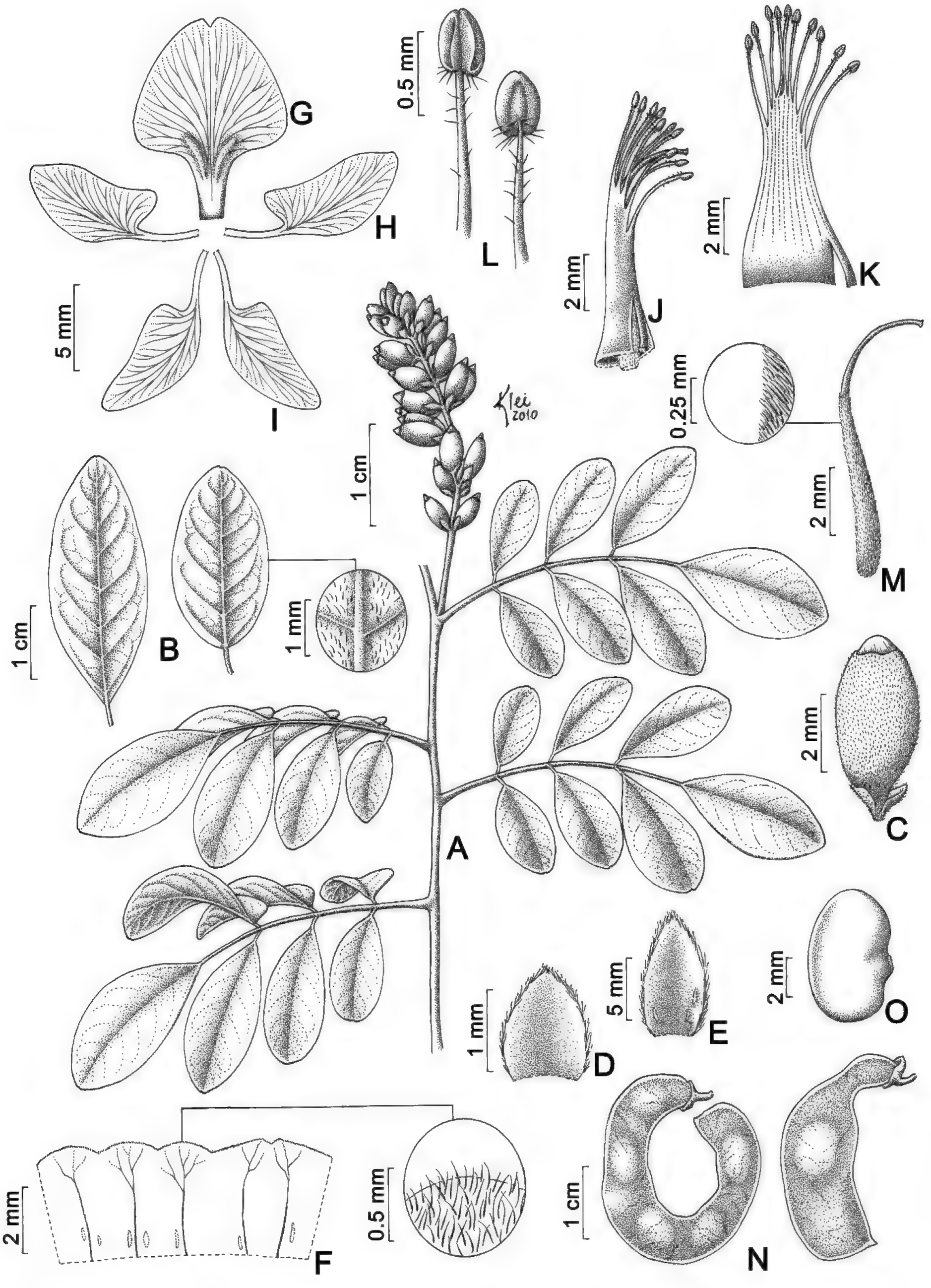

Figure 1. *Muellera tozziana* M. J. Silva. —A. Flowering branch. —B. Leaflets, abaxial surfaces, with the magnified insert showing the brief strigose indumentum. —C. Floral bud. —D. Secondary bract. —E. Bracteole. —F. Calyx opened out. —G. Standard. —H. Wings. —I. Keel petals. —J. Side view of staminal tube. —K. Staminal tube opened out. —L. Anthers, ventral view to right and dorsal view to left. —M. Gynoecium, with magnified insert showing the dense sericeous indumentum. —N. Fruits. —O. Seed, lateral view. A–M from the holotype *F. E. Miranda et al. 538* (INPA); N–O from *D. C. Daly et al. 1585* (K).

obtuse to rounded, or, less commonly, retuse to emarginate, membranaceous to papyraceous, discolorous, adaxial surface bright green, glabrous, abaxial surface pale green, strigulose; venation brochidodromous, midvein and secondary veins impressed on both surfaces, the secondary veins forming angles of 35° to 45° with the midvein. Pseudoracemes axillary, solitary with the flowers in pairs along the rachis, congested; peduncle 2–8 mm, rachis 2–4.4 cm, both angulate, glabrous or shortly tomentose, trichomes

hyaline to yellowish, secretory cavities present; primary bract (at base of inflorescence) caducous, secondary bracts (surrounding the pedicels) 0.9–1 × 0.8–0.9 mm, broadly ovate to triangular, base obtuse to truncate, apex acute to obtuse, ferruginous tomentose externally, persistent, tertiary bracts (at base of each pedicel) 0.3–0.5 mm, oblong, base truncate, apex rounded, ferruginous tomentose externally, caducous; bracteoles (situated on upper third of pedicel) 1–1.1 × 0.4 mm, ovate, base truncate, apex obtuse, opposite, ferruginous tomentose externally; secretory cavities present on the bracts and bracteoles. Flowers purple to lilac, calyx and corolla without secretory cavities; pedicels 2.9–3 mm, subcylindrical, ferruginous-tomentose; calyx 2.9–3.1 × 3–3.4 mm, campanulate, subtruncate, subcoriaceous, pubescent externally, slightly gibbous on the vexillary margin; standard 8.5–9 × 7–7.8 mm, ovate, base subtruncate to slightly cordate, apex emarginate, basal callosities thickened inside in the middle of the petal, glabrous internally and shortly sericeous on the central-apical region of the dorsal surface, especially along the veins, claw 2.9–3 mm; wings 7.4–7.5 × 3–3.1 mm, ovate-falcate, base auriculate on the vexillary margin, apex obtuse, sericeous externally, claw 3.9-4 mm; keel petals 6–7 × 2.9–3 mm, ovate-falcate, umbonate above the claw, base truncate on the vexillary margin, apex obtuse, sericeous externally, claw 3.9–4 mm; staminal tube 7–7.2 × 1.8–1.9 mm, membranous, slightly bicallose at the base, anthers 0.7–0.8 mm, orbicular to ± oblong, pubescent together with the free portion of the filaments and staminal tube; ovary 7.6–7.8 × 1–1.1 mm, ± narrowly conicoid, slightly curved on the vexillary margin, densely sericeous, without secretory cavities, style 6.3–7 mm, slightly curved, glabrescent, stigma punctiform, sessile; ovules 6 or 7 per ovary, ca. 0.3 mm, irregularly reniform; hypanthium ca. 1 mm, asymmetric. Pod 2.1–5.5 × 1–1.3 cm, 1- to 5-seeded, indehiscent, conspicuously falcate or more rarely oblong-falcate, base cuneate, apex acute to obtuse, upper margin discreetly thickened, glabrescent; calyx and remnants of other floral parts, persistent; seeds 4 or 5, 2–2.4 mm, reniform, light brown.

Distribution and habitat. *Muellera tozziana* is endemic to Brazil, with a disjunct distribution between the states of Pará (Tucuruí, Itupiranga, and adjacent areas), and Mato Grosso (Rio Araguaia). The new species grows in rocky areas and along igapó forest margins or in partially flooded areas, on sandy or clay soils.

IUCN Red List category. *Muellera tozziana* is known from no more than nine localities, eight of which are in the state of Pará, with only one in the state of Mato Grosso. Following IUCN Red List criteria (IUCN, 2001), the species has been evaluated as Vulnerable (VU D2, with a limited distribution), and the individuals were not abundant where collected.

Phenology. The new species was observed to flower in September and October and in fruit from October to February.

Etymology. The specific epithet honors Ana Maria Goulart de Azevedo Tozzi, a Brazilian botanist at the Universidade Estadual de Campinas, São Paulo, for her valuable contributions to the knowledge of Brazilian legumes and for introducing me to the beautiful world of the genus *Muellera*.

Relationships. *Muellera tozziana* is differentiated from its congeneric taxa by its curved, falcate or oblong-falcate fruits, these being slightly thickened along the upper margin and glabrescent. The flowers with the staminal tube, free portion of the filaments and anthers are consistently pubescent; the calyx is subtruncate; the leaves are diminutive, with predominantly orbicular to rounded leaflets, these delicate and glossy on the upper surface. Morphologically the new species resembles *M. denudata* with which it often has been confused in herbarium collections, because in some cases both taxa share a similar number and form of the leaflets and environmental preferences. However, the new species differs from *M. denudata* by the flowers measuring ca. 10 mm (vs. 12.5 mm in *M. denudata*), by the nearly truncate calyx (vs. a calyx with at least three distinct lobes), the pubescence of the flowers throughout the staminal tube, the free portion of the filaments and anthers (vs. glabrous or only the anthers pubescent), the ovate wings with the base auriculate on vexillary margin (vs. elliptic to oblong-falcate with the base truncate), and curved or falcate to oblong-falcate fruits, which are usually glabrescent (vs. the oblong and densely ferruginous tomentose).

Paratypes. BRAZIL. **Mato Grosso:** Rio Araguaia, 13°22′S, 50°40′W, 31 Oct. 1978 (fr.), *A. A. Dias 42* (RB). **Pará:** Itupiranga, Mata de várzea na margem do rio, 4 Feb. 1976 (fr.), *N. T. Silva 4270* (IAN, K not seen, K photo); Ilha do Deserto, Rio Xingu, abaixo do Rio Bacajá, 20 Nov. 1980 (fr.), *G. T. Prance, D. G. Campbell, D. C. Daly, U. Maciel, M. G. da Silva, R. P. Bahia & M. R. dos Santos 26358* (K, MICH); Rio Tocantins, 1 km E de Breu Branco, 44 km S de Tucuruí, na antiga BR 422, 4°04′S, 49°38′W, 17 Nov. 1981, *D. C. Daly, R. Callejas, M. G. da Silva, E. L. Taylor, C. Rosario & M. R. dos Santos 1392* (K, K photo, NY); próx. Igarapé Cajazeirinha, ca. 30 km N de Itupiranga, 4°01′S, 49°21′W, 27 Nov. 1981 (fr.), *D. C. Daly, R. Callejas, M. G. da Silva, E. L. Taylor, C. Rosario & M. R. dos Santos 1585* (K, K photo, NY); entre Marabá e Tucuruí,

5°00′S, 49°20′W, 23–24 Nov. 1981 (fr.), *J. Jangoux, A. B. Anderson, M. J. Balick, J. M. F. Frazão, L. R. Marinho & N. A. Rosa 1694* (K); BR422, Km. 45, 5 Nov. 1983 (fr.), *J. Ramos 1015* (INPA); 14 Sep. 1983 (fl.), *J. Revilla et al. 8677* (INPA).

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Euphorbia rayturneri (Euphorbiaceae), a New Species from Southwestern New Mexico, United States

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Abstract. *Euphorbia rayturneri* V. W. Steinm. & Jercinovic (Euphorbiaceae), a new species endemic to southwestern New Mexico, United States, is described and illustrated. This summer annual occurs in desert grassland and is known from three collections made in Grant, Hidalgo, and Luna counties at elevations of 1400–1700 m. Given its limited distribution and small population size, we propose that the species is best considered as CR, or Critically Endangered, according to IUCN Red List criteria. The new species belongs to *Euphorbia* L. sect. *Anisophyllum* Roep. on the basis of possessing interpetiolar stipules and opposite leaves that are asymmetrical at the base. It is characterized by being a pubescent, prostrate herb with serrulate leaves that often have a red blotch in the center and an ovary with undivided styles.

Key words: *Euphorbia*, Euphorbiaceae, IUCN Red List, New Mexico, United States.

Despite the flora of the southwest United States having been relatively well studied, our basic knowledge of the plants in the region is still far from complete, and new species continue to be encountered and described at a constant rate (Ertter, 2000). New Mexico ranks fourth among the 48 continental United States in terms of plant diversity (Legler, 2010). In the past decade at least 10 new species of vascular plants have been described from the state, and 350 new records have been reported (Kelly Allred, pers. comm., 2010). With at least 43 native species, the genus *Euphorbia* L. (Euphorbiaceae) is one of the most speciose genera in New Mexico (Allred, 2012). It is therefore not surprising that recent field exploration and the study of existing collections have resulted in the discovery of a distinctive annual species of *Euphorbia* that does not correspond to any known member of the genus. This new species is described here, and information is provided about its habitat, distribution, conservation status, and taxonomic affinities.

Euphorbia rayturneri V. W. Steinm. & Jercinovic, sp. nov. TYPE: U.S.A. New Mexico: Grant Co., Pitchfork Ranch, 32°25.072′N, 108°21.169′W, 1605 m, 23 Sep. 2008, *E. Jercinovic 827* (holotype, NMC; isotypes, IEB, KSC, MICH, MO, UNM). Figures 1, 2.

Haec species inter congeneros *Euphorbiae* L. sect. *Anisophylli* Roep. quoad plantam prostratam annuam etiam folia serrulata saepe ad medium rubromaculata *Euphorbiae maculatae* L. similis, sed ab ea stylo indiviso atque seminibus leviter majoribus distinguitur.

Herb annual, prostrate, mat-forming with various primary stems extending radially from a slender taproot. Stems to 8 cm, terete, strigulose with white, recurved hairs 0.1–0.2 mm, pubescence distributed uniformly around the circumference of the stem; internodes 0.6–2.2 cm. Stipules interpetiolar, separate, filiform, 0.6–0.9 mm, pilose or strigulose; leaves opposite; blades ovate to elliptic, often slightly falcate, 0.5–1.1 × 0.2–0.5 cm, apex acute, margin sharply serrulate, base asymmetrical, one side cordate, the other round to attenuate, upper surface glabrescent with scattered hairs, often with a red spot toward the center, lower surface strigulose, only the midvein evident; petiole 0.5–0.9 mm. Cyathia solitary; peduncles 0.5–1.6 mm. Involucre obconical, 0.9–1.2 × 0.8–1.2 mm, outer surface strigulose, inner surface sparsely pilose, lobes subulate, 0.2–0.4 mm, pilose; glands 4, circular to transversely oblong, 0.2 × 0.2–0.3 mm, green, yellow, or light pink, convex; appendages absent or if present reduced to a narrow margin flanking the outer portion of the gland, less than 0.1 × 0.2–0.3 mm, entire, white to pink. Staminate flowers 5 to 8. Gynophore glabrous, exserted from the involucre 1.4–1.8 mm; ovary 3-lobed, strigulose to canescent; styles undivided, 0.3–0.4 mm, tapering to the stigmatic tips, pink to red, glabrous. Capsules oblate, 3-lobed, 1.7–2 × 2.2–2.7 mm, strigulose; columella 1.5–1.9 mm. Seeds not carunculate, broadly ovoid, nearly triangular in cross

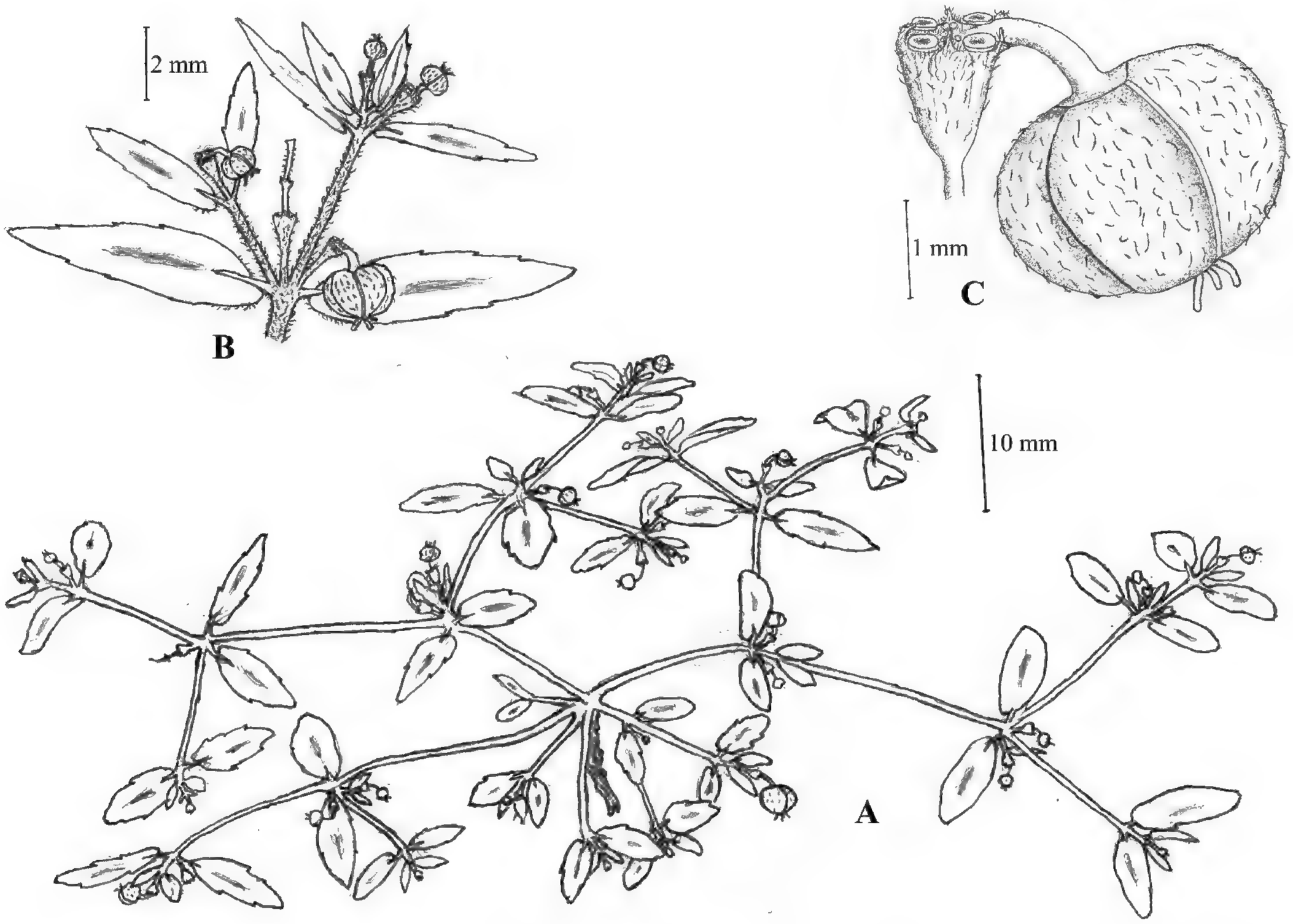

Figure 1. *Euphorbia rayturneri* V. W. Steinm. & Jercinovic. —A. Fertile habit. —B. Flowering branch. —C. Cyathium. A–C taken from the holotype, *E. Jercinovic 827* (NMC).

section, 1.2–1.4 × 1.0–1.1 mm, tan to light gray when immature, becoming brown to blackish brown, apex a low, blunt point, base truncate, dorsal keel prominent, with 2 well-defined transverse ridges that do not pass through the dorsal keel.

Distribution and habitat. *Euphorbia rayturneri* is known only from southwestern New Mexico, United States, where it occurs in Grant, Hidalgo, and Luna counties at elevations of 1400–1700 m. Given the close proximity of the Gray Ranch to the Mexican border (less than 10 km at its southernmost limit), *E. rayturneri* may also occur in the adjacent state of Chihuahua. The type locality, the Pitchfork Ranch, is located about 17 miles north of Interstate 10 along Separ Road. The ranch property consists of roughly 12,000 acres just west of the Continental Divide. It includes several miles of the Burro Cienaga, which

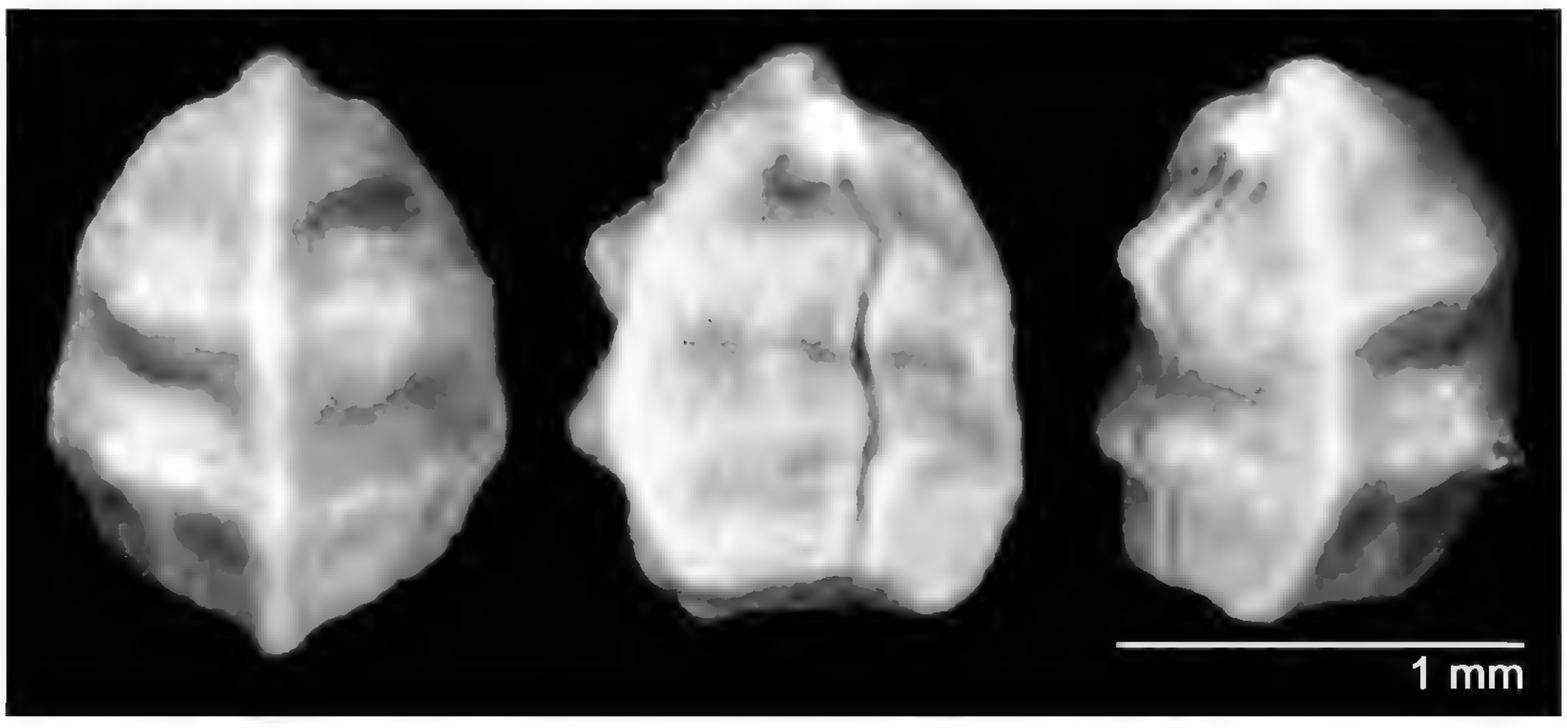

Figure 2. *Euphorbia rayturneri* V. W. Steinm. & Jercinovic. Seeds. Taken from the isotype, *E. Jercinovic 827* (MICH).

drains the southeastern flank of the Big Burro Mountains. The area shows influences of several floristic regions: the Chihuahuan Desert to the southeast, the Sonoran Desert to the southwest, and the vast Gila Wilderness forest to the north. It occurs in desert grassland habitats, and among the associated taxa are *Gutierrezia* Lag., *Isocoma tenuisecta* Greene, and *Xanthisma gracile* (Nutt.) D. R. Morgan & R. L. Hartm. (Asteraceae); *Cylindropuntia spinosior* (Engelm.) F. M. Knuth (Cactaceae); *Juniperus coahuilensis* (Martínez) Gaussen var. *arizonica* R. P. Adams (Cupressaceae); *Euphorbia davidii* Subils, *E. indivisa* (Engelm.) Tidestr., and *E. serpyllifolia* Pers. (Euphorbiaceae); *Prosopis glandulosa* Torr. (Fabaceae); *Mollugo verticillata* L. (Molluginaceae); *Aristida ternipes* Cav., *Bouteloua barbata* Lag., and *Setaria leucopila* (Scribn. & Merr.) K. Schum. (Poaceae); and *Fallugia* Endl. (Rosaceae).

IUCN Red List category. *Euphorbia rayturneri* is known only from three localities in New Mexico. Turner collected three plants in September 1996, and despite attempts in the late 1990s to relocate the species, he was unable to find additional individuals in its original area. Spellenberg found the species in 1981, but numerous visits to his collection site in the summer and fall of 2009 also failed to turn up any additional specimens. At this time, the only known location with a viable population is the type locality on the Pitchfork Ranch. However, the population is highly localized, and an informal survey of approximately 30 minutes' duration in September 2009 revealed only 10 to 12 plants contained in an area of ca. 2500 m^2. Although a careful assessment would be beneficial, we believe that, following IUCN Red List criteria (IUCN, 2001), the species is best considered as CR, or Critically Endangered, owing to the small extent of occurrence, limited area of occupancy, reduced size of its known populations, severely fragmented distribution with only three known localities, and the possibility that it has been extirpated at two of these localities.

Etymology. It is a pleasure to name *Euphorbia rayturneri* after the botanist Ray M. Turner (1927–), author of numerous publications on the plants and vegetation of the southwest United States and northwest Mexico. Among his most noteworthy contributions are *The Changing Mile* (Hastings & Turner, 1965) and *Sonoran Desert Plants: An Ecological Atlas* (Turner et al., 1995). He collected the new taxon in 1996, and although not the first to encounter the species, he was the first to recognize its distinctiveness and bring it to our attention.

Phenology. *Euphorbia rayturneri* is an annual that responds to summer monsoonal rains. It has been collected with flowers and fruits in August and September but likely is reproductive until at least October.

Taxonomic discussion. Based on the possession of interpetiolar stipules and opposite leaves that are asymmetrical at the base, *Euphorbia rayturneri* belongs to *Euphorbia* sect. *Anisophyllum* Roep., as defined by Yang et al. (2012). During the past 70 years, this section has been recognized as either the segregate genus *Chamaesyce* Gray (e.g., Webster, 1967; Mayfield, 1993; Jercinovic, 2007) or *Euphorbia* subg. *Chamaesyce* Raf. (e.g., Wheeler, 1941; Johnston, 1975; Steinmann & Felger, 1997). Bruyns et al. (2006) greatly expanded the concept of *Euphorbia* subg. *Chamaesyce* to include a large assemblage of species that had previously been placed in various subgenera of *Euphorbia*. Following this modification, *Euphorbia* sect. *Anisophyllum* is the oldest legitimate name at the rank of section that corresponds to *Chamaesyce* or *Euphorbia* subg. *Chamaesyce* as previously recognized. The New Mexican species of *Euphorbia* sect. *Anisophyllum* were recently treated by Jercinovic (2007), and the discovery of this new species brings to 28 the number of species now known for *Euphorbia* sect. *Anisophyllum* from New Mexico.

The first gathering of *Euphorbia rayturneri* was determined to be *E. supina* Raf. (a synonym of *E. maculata* L.), and the two taxa are likely closely related and are similar in being pubescent, prostrate annuals with serrulate leaves that often have a red blotch in the center. However, *E. rayturneri* is distinct from *E. maculata* by the possession of undivided styles and slightly larger seeds (1.2–1.4 × 1–1.2 mm vs. 1–1.2 × 0.6-0.9 mm). Entire styles are an otherwise uncommon feature within *Euphorbia* sect. *Anisophyllum*.

Paratypes. U.S.A. **New Mexico:** Luna Co., rocky arroyo crossing NM 61, 7.2 mi. E of NM 180, 24 Aug. 1981, *R. Spellenberg 6217* (NMC); Hidalgo Co., S of Animas, Gray Ranch, Sep. 1996, *R. M. Turner 96-19* (ARIZ); same as the type locality, 22 Sep. 2009, *E. Jercinovic 925* (MO, NMC).

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Petrocosmea melanophthalma, a New Species in Section *Deianthera* (Gesneriaceae) from Yunnan, China

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ABSTRACT. *Petrocosmea melanophthalma* Huan C. Wang, Z. R. He & Li Bing Zhang, an attractive new species (Gesneriaceae, *Petrocosmea* sect. *Deianthera* W. T. Wang) from Yunnan, China, is described and illustrated. It is similar to *P. kerrii* Craib in the zygomorphic calyx and brevirostrate anther. The new species differs from the latter by its peltate leaves and the blue corolla with two striking black spots on the tube, as well as the geniculate filaments of the stamens that thicken above the middle. *Petrocosmea melanopthalma* was found on basalt cliffs in evergreen broad-leaved forest on Mopan Shan.

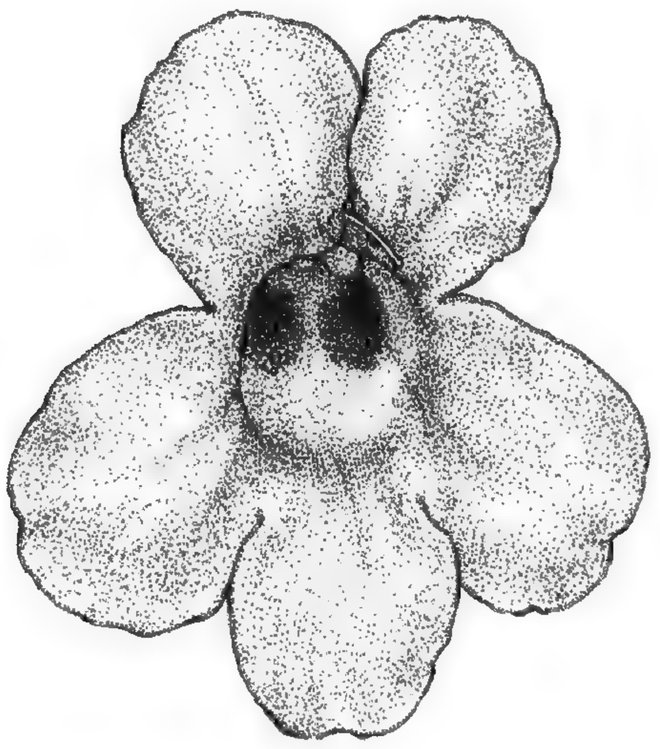
Key words: China, Gesneriaceae, IUCN Red List, *Petrocosmea*, Yunnan.

Petrocosmea Oliv. is a small genus of Gesneriaceae established by Oliver with the single species *P. sinensis* Oliv. (Oliver, 1887). Plants in this genus are perennial, acaulescent herbs with entirely basal leaves. The inflorescences are cymose, axillary, 1- to 4- (to 7-) flowered; the corolla can be blue to purple or white and is zygomorphic and bilabiate. There are two stamens with basifixed anthers and parallel thecae; there are three staminodes, but these can be only one or absent. There is no disc; the ovary is 1-loculed with two placentas in parietal orientation; the single stigma is terminal, capitate, and undivided (Li & Wang, 2004). Taxonomic revision of the genus *Petrocosmea* was first provided by Craib (1919) and later by Wang (1985). Twenty-seven species and four varieties were recognized by W. T. Wang, classified into three sections: *Petrocosmea* sect. *Petrocosmea*, *Petrocosmea* sect. *Anisochilus* Hemsl., and *Petrocosmea* sect. *Deinanthera* W. T. Wang (Wang, 1985). New reports and taxonomic novelties of this genus have been consistently reported (e.g., Wang et al., 1990, 1998; Li & Wang, 2004; Wei & Wen, 2009; Guo et al., 2010; Middleton & Triboun, 2010; Zhao & Shui, 2010) such that *Petrocosmea* currently comprises 32 species and four varieties. The genus is native to Asia, occurring in China, northeastern India, Myanmar, Thailand, and southern Vietnam. Approximately 24 species are concentrated on the Yunnan-Guizhou Plateau and most species restrict to relatively small geographical areas in distributions. Herein we describe a new species of *Petrocosmea*, in section *Deinanthera* sensu W. T. Wang (1985), from basalt cliffs in south-central Yunnan.

Petrocosmea melanophthalma Huan C. Wang, Z. R. He & Li Bing Zhang, sp. nov. TYPE: China. Yunnan: Xinping Co., Mopan Shan, 23°56.60′N, 101°58.49′E, on basalt cliffs in evergreen broad-leaved forest, 2200–2300 m, 26 May 2005, *H. C. Wang 20050321* (holotype, YUKU; isotypes, CDBI, KUN, MO, YUKU). Figures 1, 2.

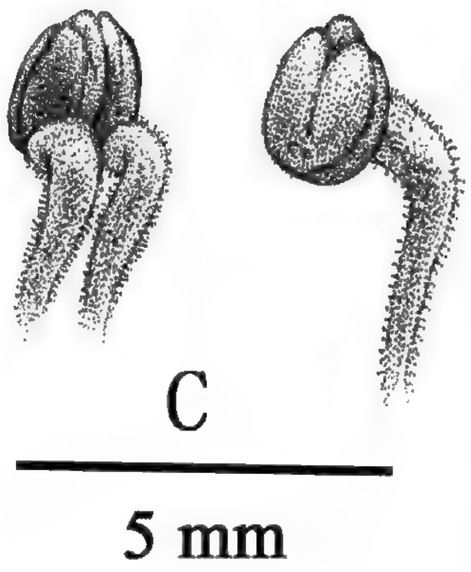
Species nova *P. kerrii* Craib affinis, sed ab ea foliis peltatis, corolla caerulea tubo intus basi maculis nigris ellipticis duabus ornata atque filamentis supra medium incrassatis geniculatisque quam antheris longioribus differt.

Perennial, small herbs; rhizomes short, ca. 5 mm. Leaves 10 to 25, basal, crowded, the inner leaves



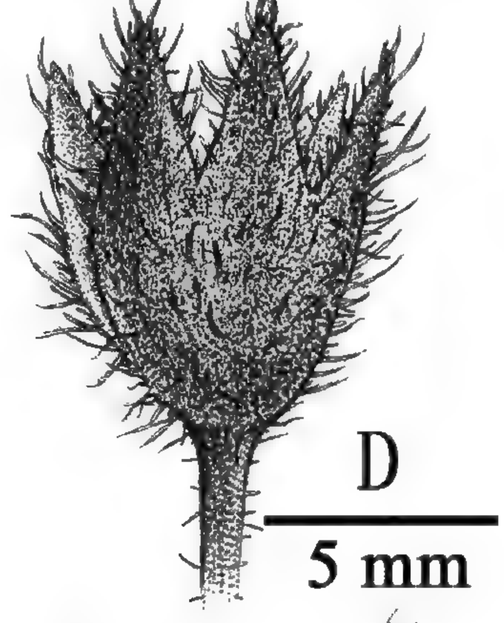
B

10 mm



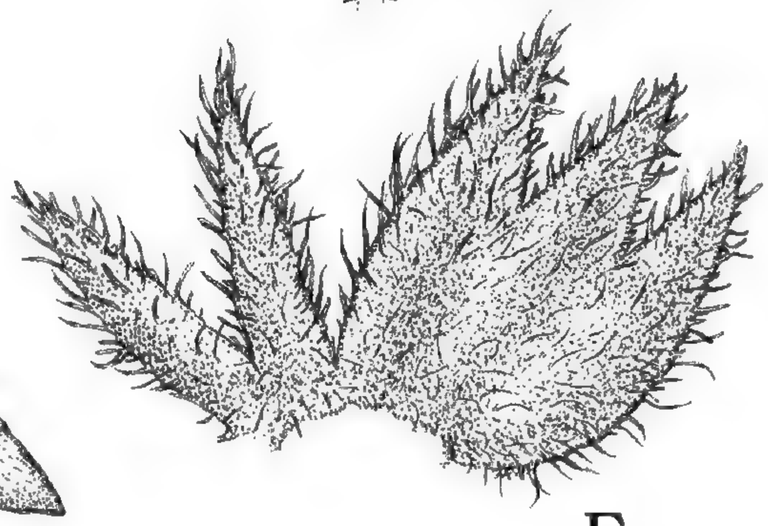
C

5 mm



D

5 mm

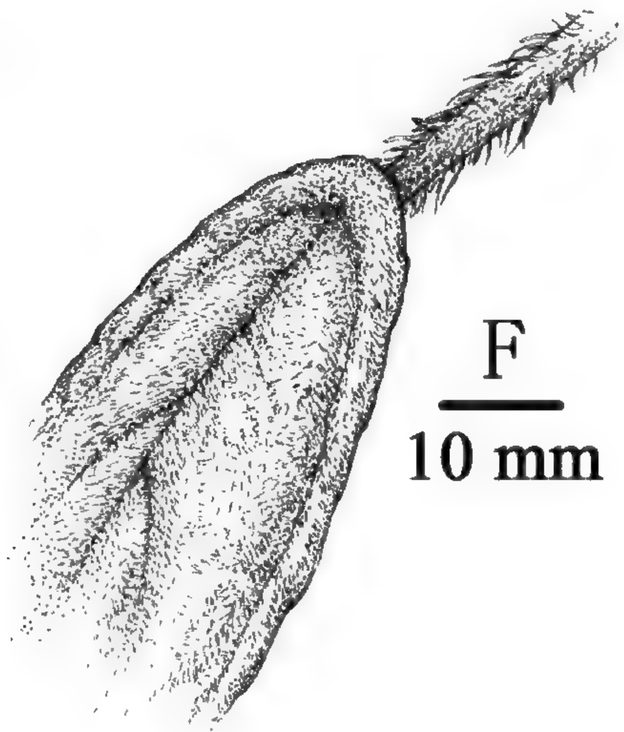


E

5 mm

A

20 mm



F

10 mm

Figure 1. *Petrocosmea melanophthalma* Huan C. Wang, Z. R. He & Li Bing Zhang. —A. Fertile plant habit. —B. Flower. —C. Anther. —D. Calyx and style. —E. Calyx, flattened. —F. Leaf base. Drawn by Che-Wei Lin from the holotype, *H. C. Wang 20050321* (YUKU).

with petioles short or absent, the outer leaves with long petioles to 7 cm; leaf blades flaccid, slightly papery when dry, the outer blades narrowly elliptic, oblong or ovate-oblong, rarely lanceolate, 4–7(–10) × 1–2.5(–4) cm, the inner blades ovate or suborbicular, 1–3.5 × 0.6–2 cm, the blade apex acute, the base peltate, margin repand, adaxial blade surface densely pubescent, abaxial surface purple, short glandular, densely adpressed villous, lateral veins 4 to 8 on either side of midrib; petioles densely adpressed,

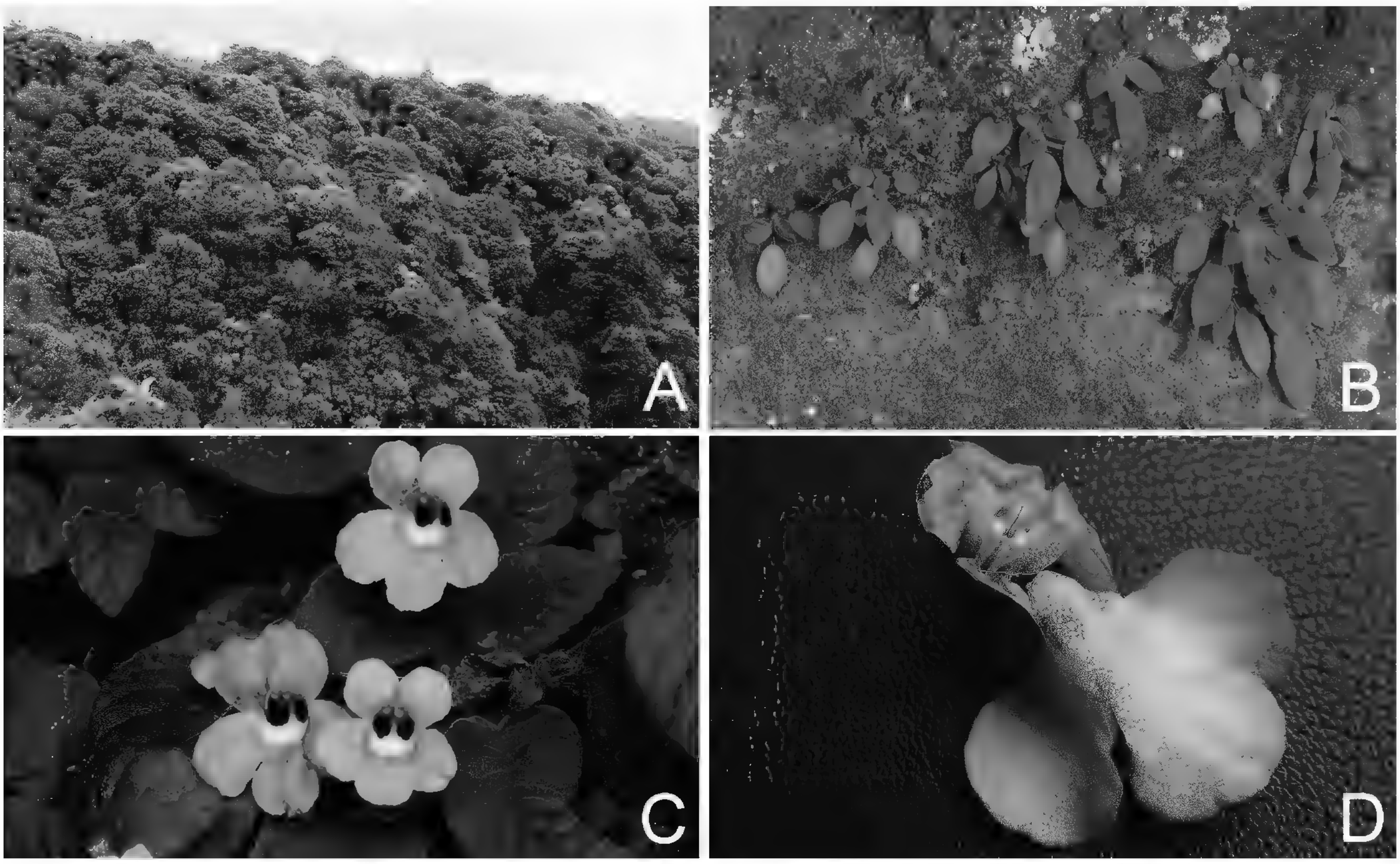


Figure 2. *Petrocosmea melanophthalma* Huan C. Wang, Z. R. He & Li Bing Zhang. —A. Habitat at the type locality, evergreen forest on Mopan Shan in Xinping county. —B. Plant habit on cliff surfaces at the type locality. —C. Close-up of fertile plants. —D. Corolla dissected to show the androecium inserted at the base of the corolla tube.

villous, base usually ferruginous, 1–7 cm. Scapes 1 to 5 (to 10), 3–5 cm tall, densely appressed villous; bracts 2, opposite, linear, ca. 3.5 mm; cymes usually 1-flowered; pedicels 1–1.5 cm. Calyx zygomorphic, 6–7 mm, unequally divided into 3 lobes from base, outer surface densely villous, inner surface glabrous, the adaxial calyx lobe larger, 3-dentate almost to middle, 4–6 mm broad, the abaxial calyx lobes 2, smaller, entire, narrowly triangular to lanceolate, ca. 1–1.8 mm broad. Corolla blue, bilabiate, 1.2–1.6 cm, externally puberulent, internally glabrous or somewhat puberulent, the adaxial corolla lip usually shorter than abaxial lip, corolla tube 6–8 mm, with 2 large black maculae evident on the abaxial tube surface internally; adaxial corolla lip ca. 0.5–0.7 mm × 15–2 cm, 2-lobed, lobes with rounded apex, abaxial lip ca. 0.6–0.8 × 2–2.8 cm, 3-lobed, lobes with rounded apex; stamens 2, filaments inserted on base of corolla, puberulent, ca. 3.5 mm, geniculate and thickened above the middle, anthers ovate, cordate at apex, ca. 2 × 1 mm, apex brevirostrate; staminodes 2, linear, puberulent; pistil ca. 13 mm; ovary ca. 3 mm, narrowly ovate, the style sparsely puberulent near base. Capsule ellipsoid, 3–4 mm.

Distribution and habitat. *Petrocosmea melanophthalma* is known only from the type locality in Xinping Co., in south-central Yunnan Province, in southwestern China. It was observed to grow on basalt cliffs in evergreen broad-leaved forest, predominated by species of *Lithocarpus* Blume, at altitudes of 2100–2300 m.

IUCN Red List category. *Petrocosmea melanophthalma* is known only from Mopan Shan, Xinping Co., Yunnan, where its distribution area is less than 5 km^2 and the total number of individuals is approximately 500–800 (D1, D2). Following the IUCN criteria (IUCN, 2008), this species should be categorized as Vulnerable (VU).

Phenology. According to field observations and experiments in cultivation, *Petrocosmea melanophthalma* flowers from May to June when the dry season comes to an end on the Yunnan Plateau. Although we have carried out field surveys several times in the type locality and in adjacent areas, fruits were largely lacking and have been rarely collected.

Etymology. The specific epithet melanophthalma is derived from the Greek prefix "melan-" or black and the Greek "ophthalmos" or eye, referring to the two black eye-like spots on the corolla tube.

Relationships. *Petrocosmea melanophthalma* differs from previously known species in the genus. It is

Table 1. Morphological comparison of *Petrocosmea melanophthalma* Huan C. Wang, Z. R. He & Li Bing Zhang and similar species in southeastern Asia.

	P. melanophthalma	*P. kerrii* Craib	*P. pubescens* D. J. Middleton & Triboun	*P. coerulea* C. Y. Wu ex W. T. Wang
Leaf blade	outer leaves narrowly elliptic, oblong, ovate-oblong, rarely lanceolate, 4–7 × 1–2.5 cm; the inner ovate or suborbicular; apices acute; bases peltate	all leaves similar, elliptic to rhombic-elliptic or ovate, 1.8–13.5 × 1.2–8.5 cm; apices widely acute to obtuse; bases oblique, not peltate	all leaves similar, suborbicular to very broadly obovate, 4–9.3 × 3.8–9 cm; apices rounded; bases peltate	all leaves similar, oblong to elliptic or elliptic-ovate, 1–6.6 × 0.7–2.2 cm; apices slightly obtuse; bases peltate
Cyme	usually 1-flowered	1- to 7-flowered	1- to 2-flowered	usually 1-flowered
Calyx symmetry	zygomorphic	zygomorphic	zygomorphic	actinomorphic
Calyx	tripartite, larger adaxial lobe trilobed	tripartite from base, larger adaxial lobe trilobed	tripartite, larger adaxial lobe trilobed	5-partite from base
Flower color and maculation	corolla blue, with two black maculae internally on abaxial tube	corolla white, not maculate	corolla blue, not maculate	corolla blue, not maculate
Anthers	ovoid, ca. 2 mm long, apices brevirostrate	ellipsoid, ca. 3 mm long, apices brevirostrate	ovoid, ca. 4 mm long, apices brevirostrate	cordate-ovoid, ca. 2.2 mm long, apices not brevirostrate
Stamen filaments	geniculate, thickened above middle, ca. 3.5 mm	straight, ca. 1.2 mm	straight, ca. 2.4 mm	straight, ca. 1.2 mm
Capsule length	3–4 mm	5–6.5 mm	10–12 mm	not known
Distribution	south-central Yunnan (Xinping Co.), China	southern Yunnan, China, northern Myanmar, and Thailand	Chiang Rai, Thailand	southeastern Yunnan (Jinping Co.), China

characterized by the peltate leaves, the zygomorphic calyx, and the blue corolla with two striking black spots evident within the abaxial corolla tube. The filaments of the two stamens are geniculate and thickened above the middle, and the anthers are apically constricted to form a short beak.

Following Wang's (1985) taxonomic treatment of this genus, this new species should be assigned to *Petrocosmea* sect. *Deinanthera* ser. *Kerrianae* W. T. Wang, as the calyx is zygomorphic and 3-lobed, and the anther is apically constricted to form a short beak. This series is currently composed of one species with two varieties, *P. kerrii* var. *kerrii* and *P. kerrii* var. *crinita* W. T. Wang. *Petrocosmea melanophthalma* differs from *P. kerrii* by its peltate (vs. nonpeltate) leaves, blue (vs. white and not maculate) corolla with two striking black maculae within the abaxial tube, and filaments that are longer than anthers (vs. being shorter than anthers), ca. 3.5 mm long (vs. ca. 1.2 mm long), geniculate and thickened above middle (vs. straight and not thickened). Both species occur in Yunnan, but *P. kerrii* extends to the south into northern Myanmar and Thailand. *Petrocosmea melanophthalma* shares some similar characters with *P. pubescens* D. J. Middleton & Triboun, such as the peltate leaves, zygomorphic calyx, and blue corolla, but differs from the latter in that its outer leaves are narrowly elliptic, oblong or ovate-oblong, and 4–7(–10) × 1–2.5(–4) cm in size, and its flower has two black spots on the corolla. *Petrocosmea melanophthalma* shares similar characters with *P. coerulea* C. Y. Wu ex W. T. Wang as well, a species also described from Yunnan, such as the peltate leaves and blue corolla, but differs from the latter in its zygomorphic (vs. actinomorphic) calyx and brevirostrate anthers. *Petrocosmea melanophthalma* is somewhat morphologically similar to *Metapetrocosmea peltata* (Merr. & Chun) W. T. Wang, which was originally placed in the genus *Petrocosmea*, but as Wang indicated (1981), the latter is characterized by an elongated rhizome, a white or reddish corolla, with the lip shorter than tube, the villous anthers, and divergent thecae. *Metapetrocosmea peltata* is known from Hainan Island in China and is not sympatric to the new species. A morphological comparison of *Petrocosmea melanophthalma* and related species is given in Table 1.

Paratype. CHINA. **Yunnan:** Xinping Co., Mopan Shan, 23°56.60′N, 101°58.49′E, on basalt cliffs in evergreen broad-leaved forest, 2200–2300 m, 30 May 2007, *H. C. Wang et al. 20070055* (YUKU).

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